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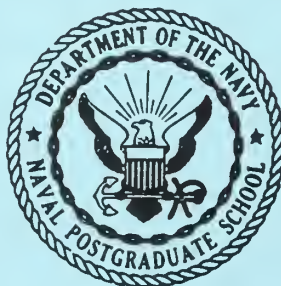
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UNITED STATES
NAVAL POSTGRADUATE SCHOOL



THESIS

P7687

AN INVESTIGATION OF AIRCRAFT
ACCIDENTS ABOARD DEPLOYED CVA'S
DURING 1962 AND 1963

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Wendell W. Powell

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AN INVESTIGATION OF AIRCRAFT
ACCIDENTS ABOARD DEPLOYED CVA'S
DURING 1962 AND 1963

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AN INVESTIGATION OF AIRCRAFT
ACCIDENTS ABOARD DEPLOYED CVA'S
DURING 1962 AND 1963

by

Wendell W. Powell

Lieutenant, United States Navy

Submitted in partial fulfillment of
the requirements for the degree of

MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

United States Naval Postgraduate School
Monterey, California

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AN INVESTIGATION OF AIRCRAFT
ACCIDENTS ABOARD DEPLOYED CVA'S

DURING 1962 AND 1963

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This work is accepted as fulfilling
the thesis requirements for the degree of

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IN

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from the

United States Naval Postgraduate School

NPS ARCHIVE

1965

POWELL, W.

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ABSTRACT

Many proposed solutions for preventing aircraft accidents in the U. S. NAVY have led to elimination of some of the obvious causal factors. Underlying factors related to Attack Carrier operating methods and pilot performance are examined for aircraft accidents which occurred during deployments from 1962 through 1963. Variables derived from CVA operating schedules for the SIXTH and SEVENTH FLEETS are illustrated and compared. Conditions surrounding aircraft accidents, such as length of time on deployment, time at sea and in port, and pilot's experience are studied to determine similarities and differences in fleet operations. Computer programs are presented which were written to process and display the data contained in ship movement reports and aircraft accident reports.

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1. Introduction and Summary.

The study of aircraft accidents that occur as a result of attack carrier operations was suggested by the U. S. Naval Aviation Safety Center. The study is to be part of a proposed fleetwide study of accidents incident to all types of carrier operations, with intent to analyze the occurrence of accidents as related to differences in methods of operations.

Attack carrier operations and their associated aircraft accidents during calendar years 1962 and 1963 form the basis for a comparison of the SIXTH and SEVENTH FLEETS. Variables were defined and calculated which pertained to individual, ship, and fleet operational accidents with the intent to distinguish where possible between the fleets.

In general, the SIXTH and SEVENTH FLEETS operated in a similar manner. The length of periods at sea for the two fleets was found to come from the same distribution. However, they were shown to differ in the length of periods spent in port. Accidents occurred in both fleets at approximately a constant time rate, with the SEVENTH FLEET having a slightly higher rate since it had 1.6 more carriers deployed on the average than the SIXTH FLEET. No significant difference was found in the number of accidents per carrier operating days for the two fleets. The distribution of accidents during a deployment for the CVA's of each fleet was found to be the same, as was the distribution of time at sea prior to an accident. Each of the CVA's was found to operate in a manner consistent with its parent fleet. The percent of accidents encountered on deployment did not differ significantly within or between the two fleets.

In this study the operational performance of the two fleets was found to be essentially the same, as was their safety performance. It is therefore concluded that variables other than those analyzed in this study must be found to distinguish between the two fleets.

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2. Data and Assumptions

Data pertaining to each aircraft accident was supplied by the U. S. Naval Aviation Safety Center in the form of an IBM punch card deck consisting of three data cards per accident. The cards contain information coded in alphanumeric form which was transferred from the original Aircraft Accident Reports. The first two cards in each sequence contain general and supplementary information, a description of the accident and primary and secondary cause factors. The third card contains personnel statistics pertaining to the pilot and crew involved in the accident. Computer programs for processing and displaying this data are listed in Appendix II.

Ship operating and employment schedules were obtained from COMNAVAIRLANT and COMNAVAIRPAC. In addition, microfilm containing individual ship movement reports were supplied by NASC. A method was developed for coding the operating status of a ship in such a way as to determine whether the ship was deployed, at sea or in port for each day in a desired time span. This served as input for a computer program to calculate variables related to the carrier's operating plan. This program is listed in Appendix II.

Detailed operational data such as flight hours, carrier landings, etc., was available on OPNAV ZULU tapes for each aviation unit involved. However, the format and content was such that this information could not be utilized in the time allotted for this study. For further explanation, see Appendix I.

In general, each of the variables to be analyzed in this study is examined in three categories, (a) combined fleets, which includes all CVA's regardless of deployed status, (b) SIXTH FLEET, which is limited to those CVA's actually deployed or enroute to or from the Mediterranean area, and (c) SEVENTH FLEET, which also is limited to those CVA's deployed or enroute to or from the SEVENTH FLEET deployment area.

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The FIRST and SECOND FLEETS are not categorized for several reasons. Primarily, sufficient data was not available for accurately determining periods at sea and in port since much of this operation is on a local area basis, and the carriers do not submit movements reports. Also, much of the time is spent in training new personnel, on RAG qualifications and individual ship proficiency training. These conditions are not typical of a ready carrier on deployment.

A deployment is assumed to begin when a carrier departs CONUS enroute to a forward area, and is terminated when the carrier returns to CONUS. Although not technically assigned to their deployed fleet while enroute, many CVA's conducted operations which were under conditions similar to deployment, and analysis of the accidents occurring during these enroute operations should be included for completeness.

Variables related to in port/at sea schedules for the SIXTH and SEVENTH FLEETS were derived primarily from ship movement reports. Any deviation from a ship's schedule as recorded by these reports is not considered in this study. Whenever a CVA was reported to be at sea, the assumption is made that flight operations were being conducted, since the available data does not permit a breakdown of the type of at-sea operations. When a ship leaves or enters a port such that more than half the day is available for operations, that day is counted as a day at sea, otherwise it is a day in port.

Accidents involving more than one aircraft are counted as multiple accidents only if the other aircraft were incident to flight. For example, an inflight collision involving two aircraft is counted as two accidents, whereas a landing accident which destroys other parked aircraft is counted as one accident. This assumption is justified since the aim of this study is to examine all aspects of accident occurrence and analyze all the data pertinent

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Age Group	Gender	Total	Normal	Abnormal
18-24	Male	10	8	2
	Female	10	8	2
25-34	Male	20	18	2
	Female	20	18	2
35-44	Male	30	28	2
	Female	30	28	2
45-54	Male	40	38	2
	Female	40	38	2
55-64	Male	50	48	2
	Female	50	48	2
65-74	Male	60	58	2
	Female	60	58	2
75+	Male	70	68	2
	Female	70	68	2

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to any accident. In the case of multiple accidents, data related to all of the involved aircraft, pilots, ships and fleets must be considered. Under this assumption, the number of accidents per CVA will differ from the published values.¹

¹NASC. U. S. Navy Aircraft Accident Statistics for the Calendar Year 1963: 47-48

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3. Composition of the Fleets.

During calendar years 1962 and 1963 there were fifteen Attack Carriers in operation. Two additional carriers were operating as CVA's at the beginning of 1962 and were reclassified as CVS's during this period. The fleets were composed as follows:

FIRST AND SEVENTH

TICONDEROGA	CVA 14
LEXINGTON ²	CVA 16
HANCOCK	CVA 19
B. H. RICHARD	CVA 31
ORISKANY	CVA 34
MIDWAY	CVA 41
CORAL SEA	CVA 43
RANGER	CVA 61
KITTY HAWK	CVA 63
CONSTELLATION ³	CVA 64

² LEXINGTON departed FIRST FLEET in August 1962 for reclassification as CVS.

³ CONSTELLATION departed Mayport in July 1962 for transfer to the PACIFIC FLEET.

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SECOND and SIXTH

INTREPID ⁴	CVA 11
SHANGRI LA	CVA 38
ROOSEVELT	CVA 42
FORRESTAL	CVA 59
SARATOGA	CVA 60
INDEPENDENCE	CVA 62
ENTERPRISE	CVA 65

The combined fleets will include all CVA's regardless of deployed status. The SIXTH FLEET and SEVENTH FLEET will include only those CVA's actually deployed or enroute to the deployed area as previously stated.

⁴INTREPID was reclassified as CVS 11 on 31 March 1962

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4. Accident Occurrence with Time.

Cumulative aircraft accidents were plotted as they occurred in time, using a two year time span beginning 1 January 1962. Fig. 1a is the plot for the combined fleets which shows that the occurrence of the 300 accidents without regard to deployed status is linear. Fig. 1b, showing 70 SIXTH FLEET accidents, and Fig. 1c, showing 103 SEVENTH FLEET accidents, also indicate a linear rate of accident occurrence.

The hazard function $h(t)$ of an underlying probability density function $f(t)$ describes the rate at which a device will fail provided it has not failed prior to a time t . The simplest form of the hazard function occurs when the failure rate is constant. It is shown in [2] that

$$h(t) = \frac{f(t)}{1-F(t)}$$

and

$$f(t) = h(t) \exp \left[- \int_0^t h(t) dt \right]$$

Since the rate of aircraft accident occurrence is approximately constant for each of the categories, the hazard function is simply the slope of the line in Figs. 1a, 1b, and 1c. Denoting this slope by λ , the underlying density function becomes

$$f(t) = \lambda \exp (- \lambda t)$$

which is the well known exponential probability density function. The constant λ is interpreted as the rate of accident occurrence and its reciprocal is the mean time to occurrence.

An estimate of the true accident occurrence rate can be made from the available data as plotted. It is known that the limiting distribution of any reasonably behaving function of a sample mean is asymptotically normal as the sample size tends to infinity. Under this assumption, the maximum likelihood estimator for the sample occurrence rate is normally distributed

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about the true rate. Since the true variance for the estimator is not known, a confidence interval about the true mean can be obtained by using the quantity

$$t = \frac{\sqrt{n-1} (\hat{\lambda} - \lambda)}{S}$$

which has the t distributed with $(n-1)$ degrees of freedom. $\hat{\lambda}$ is the same mean, S is the sample standard deviation, λ is the true accident occurrence rate, and n is the number of accidents. Therefore

$$\hat{\lambda} \pm t \left(\frac{\alpha}{2}; n-1 \right) \frac{S}{\sqrt{n-1}}$$

gives a $(1-\alpha)$ confidence interval for the true aircraft accident rate λ .

The calculations for the combined fleets reveal that the true accident occurrence rate, with 90% confidence, lies between .37 and .45 accidents per day. A region of the same confidence level for the SIXTH FLEET shows the true accident occurrence rate between .08 and .12 accidents per day. The 90% confidence region for the true rate in the SEVENTH FLEET is from .12 to .16 accidents per day.

These accident occurrence rates for the SIXTH and SEVENTH FLEETS were compared in a two-tailed test of hypothesis to determine if significant difference existed between the two fleets. For a .05 level of significance, the results show a difference in performance. However, the results were not significant at the .01 level.

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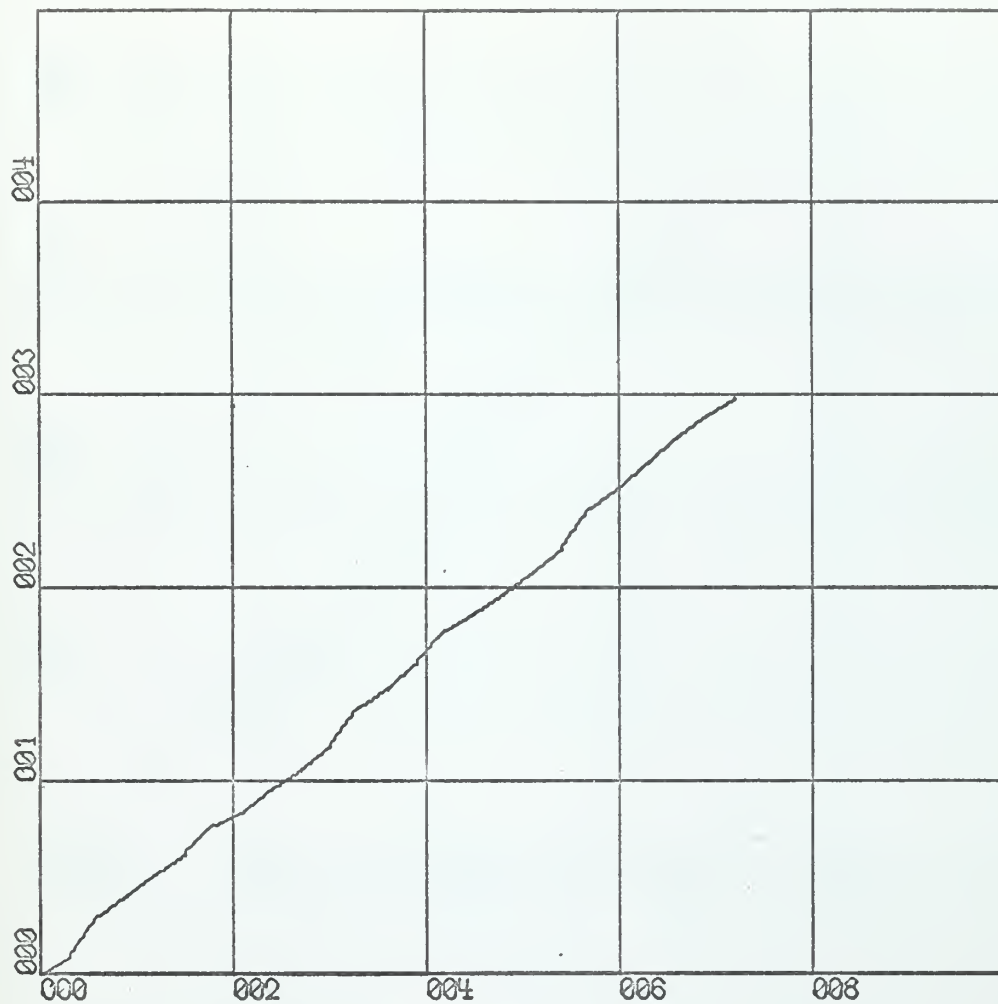
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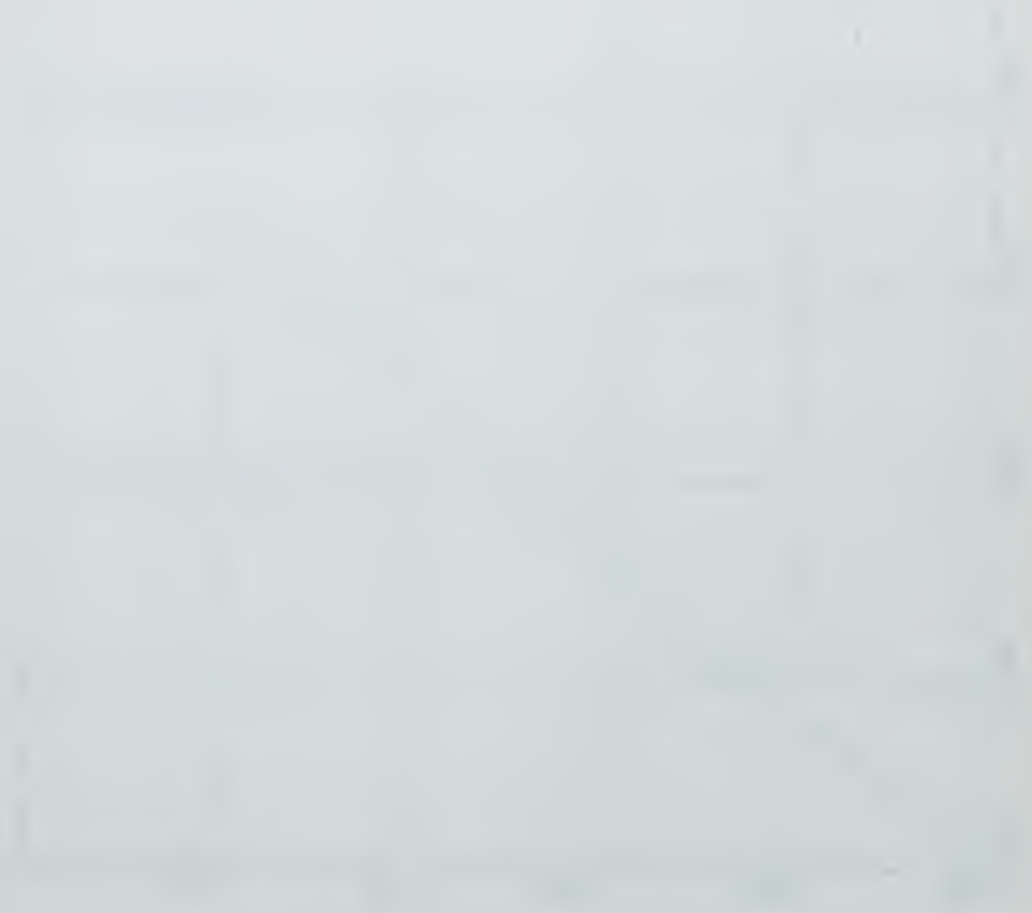
X - Scale = Days x 100

Y - Scale = Accidents x 100

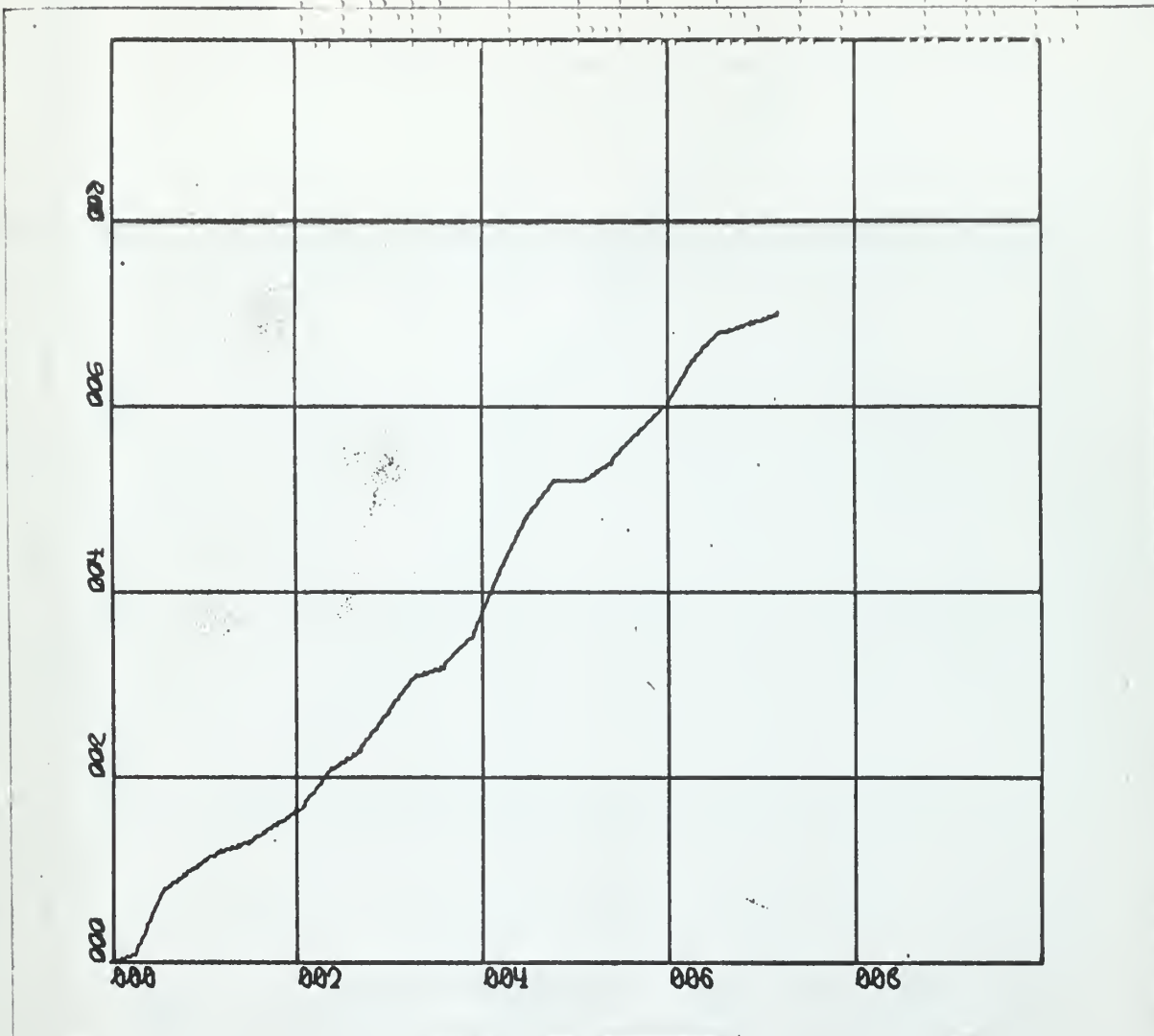
Fig. 1a. Cumulative accidents since 1 January 1962, Combined Fleets

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X-Scale=Days x 100

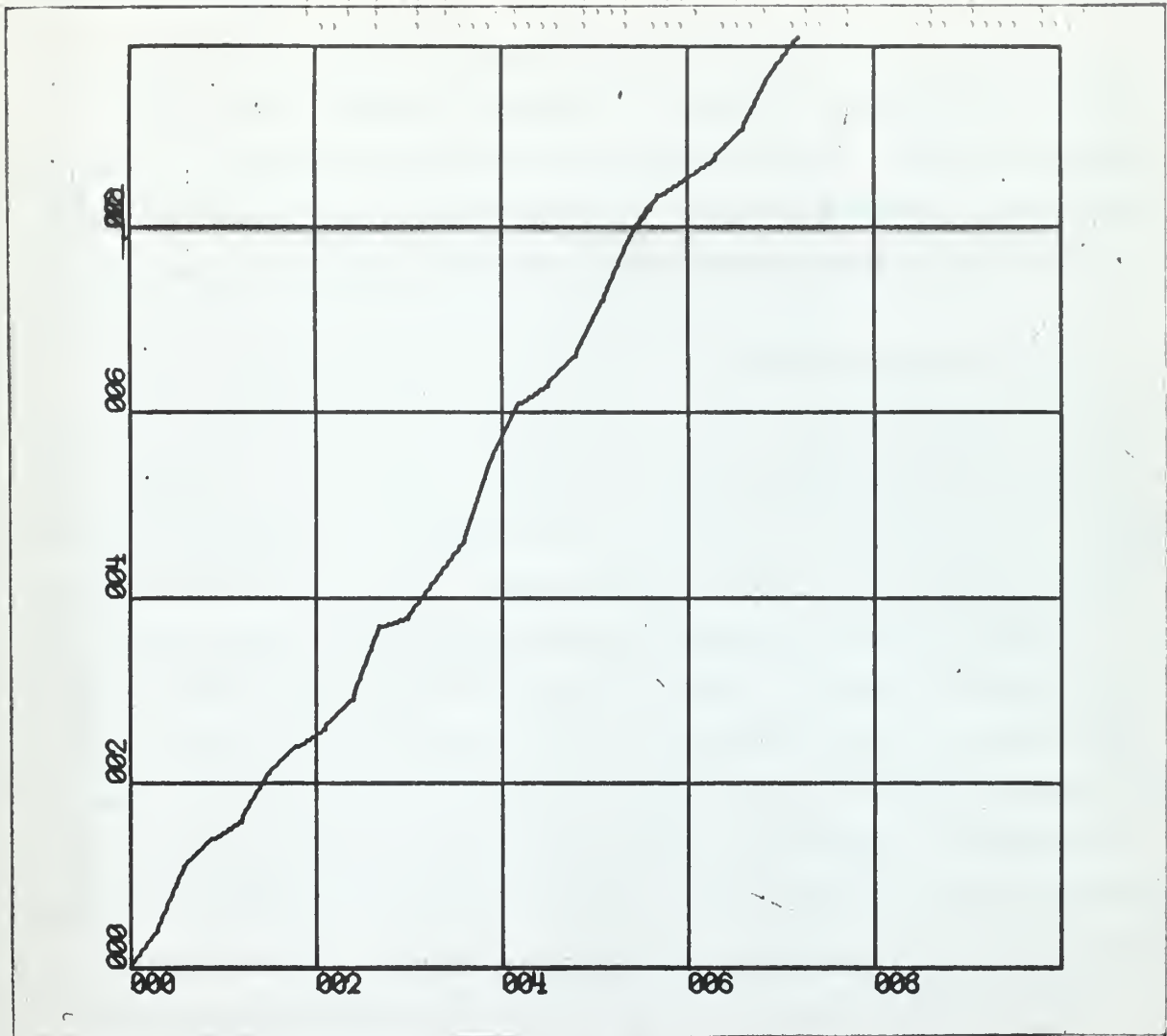
Y-Scale=Accidents x 10

Fig. 1b. Cumulative accidents since 1 January 1962, 6th FLEET

1. The first part of the paper discusses the importance of the study of the history of the United States. It is argued that the study of the history of the United States is essential for a full understanding of the country and its people. The paper then discusses the importance of the study of the history of the United States in the context of the current political and social climate. The paper concludes by arguing that the study of the history of the United States is essential for a full understanding of the country and its people.

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X-Scale=Days x 100

Y-Scale=Accidents x 10

Fig. 1c. Cumulative accidents since 1 January 1962, 7th FLEET

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5. General Comparison of Deployed Fleet Operations

Table 1 shows selected variables for the SIXTH and SEVENTH FLEETS which were computed from the ship movement reports. Carrier Operating Days is defined as the number of days at sea while deployed. Enroute or transit time is included in total deployed time to permit analysis of aircraft accidents which occurred during these periods.

During calendar years 1962 and 1963, the SEVENTH FLEET suffered more aircraft accidents than the SIXTH FLEET. However, there were on the average 1.6 more CVA's operating with the SEVENTH FLEET, and the ratio of accidents to average number of deployed carriers shows the SIXTH FLEET with the higher rate. Other variables show that the SIXTH FLEET spent more time at sea per CVA on the average than did the SEVENTH FLEET, which may account for this difference. The ratio of accidents to carrier operating days indicates that the two fleets were very nearly the same. Since this ratio is a function of the number of CVA's deployed, the amount of time spent at sea and the number of accidents, it presents an effective measure of safety performance. This measure could be improved by using the number of days in which flight operations were actually conducted instead of Carrier Operating Days. The data available did not permit this breakdown.

Fig. 2 is a plot of length of periods in port versus frequency for the two fleets. The SIXTH FLEET plot is rather uniform for periods of one to seven days with an average length of 4.38 days. The SEVENTH FLEET shows more variation with modes at four and seven days. The average stay in port was 6.49 days.

Fig. 3 depicts length of at sea periods versus frequency. The major difference appears in periods at sea greater than nine days. The average length of time at sea for the SIXTH FLEET was 9.59 days. This figure was 9.97 days for the SEVENTH FLEET.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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It is not clear from Figs. 2 and 3 whether significant difference existed in the operating schedules for the SIXTH and SEVENTH FLEETS. The two-sample Kolmogorov-Smirnov test, based on a distribution-free statistic D , tests the hypothesis that the two samples came from the same population. [1]. The two functions are accepted under the null hypothesis as coming from the same distribution if D is less than the critical value determined for some level of significance.

When the test was applied to the cumulative percentage distributions of length of periods at sea for the two fleets the maximum difference occurred at seven days giving a value for D of 16.9 percent. The critical value at the one percent level of significance was 19.0, indicating no difference in the distribution of length of at sea periods for the two fleets.

For length of periods in port the critical value at the one percent significance level was 19.7. The maximum difference in the cumulative percentage distributions was 21.8 which occurred for in port periods of eight days. Therefore the hypothesis that the two fleets had the same distribution for length of time in port must be rejected at this level.

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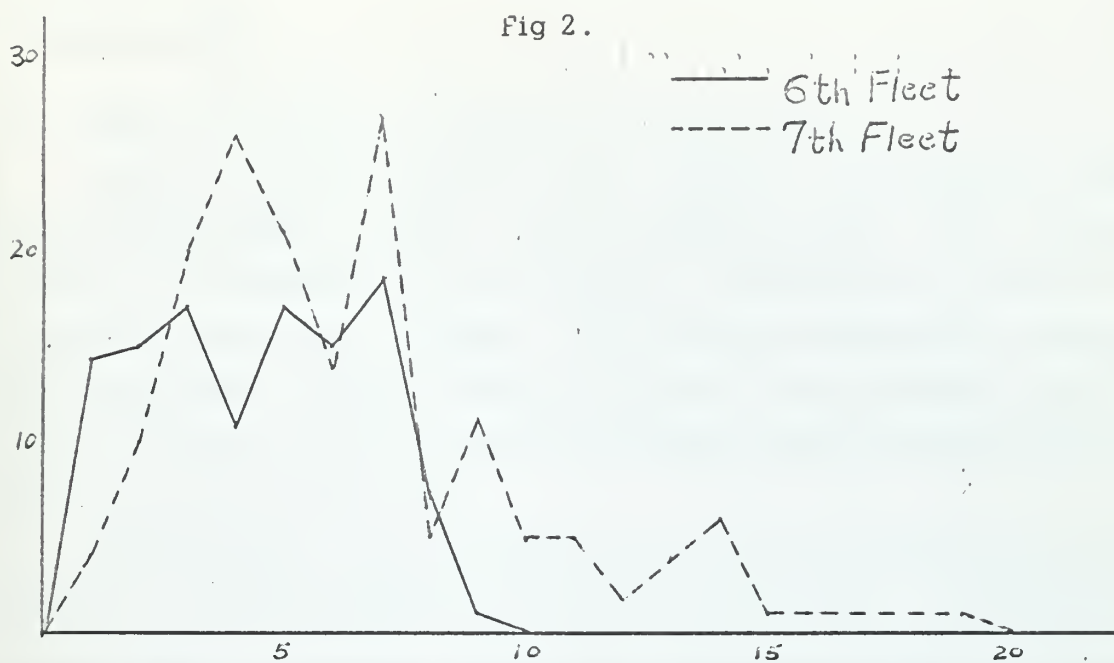
Table 1

	SIXTH	SEVENTH
Number of Accidents	70.00	103.00
Average number of CVA's deployed	2.32	3.92
Number of Accidents/average number of CVA's deployed	30.17	26.28
Carrier Operating Days	1189.00	1805.00
Days in Port	504.00	1072.00
Carrier Operating Days/Days in Port	2.36	1.68
Percent Time at Sea	70.23	62.74
Percent time in Port	29.77	37.26
Number of Accidents/carrier operating days	.059	.057

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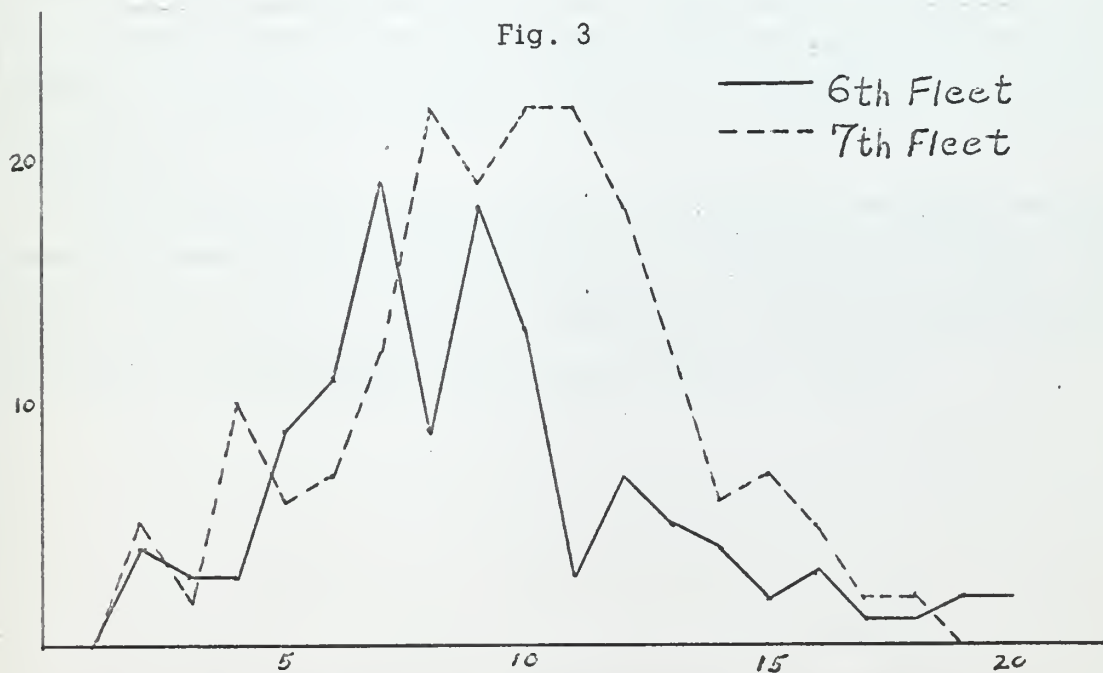
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100



X-Scale=Number of in port periods

Y-Scale=Length of in port periods (days)



X-Scale=Number of at sea periods

Y-Scale=Length of at sea periods (days)

1. The first part of the document is a list of names and their corresponding addresses. The names are listed in the first column, and the addresses are listed in the second column. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.

2. The second part of the document is a list of names and their corresponding addresses. The names are listed in the first column, and the addresses are listed in the second column. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.

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6. General Comparison of Deployed CVA Operations.

Variables related to individual ship operations are contained in Table 2 for the SIXTH FLEET and Table 3 for the SEVENTH FLEET. CVA 11 was deployed at the beginning of the test period, 1 January 1962, and was reclassified upon return to CONUS. All other ships completed at least one full deployment, and some were also deployed at the beginning or the end of the test period. This accounts for the differing values of Carrier Operating Days and days spent in port.

The percentage of total accidents that occurred on deployment for the SIXTH and SEVENTH FLEETS were 60 and 56 respectively. A likelihood ratio test of these two Bernoulli populations can be used to test the null hypothesis that the two percentages did not differ significantly. [1]. Denoting the likelihood ratio by λ , the quantity $-2 \log \lambda$ has asymptotically the chi-square distribution with one degree of freedom. Application of the test showed the chi-square value to be .34. Since this is less than the critical value of .455 at the .5 level, the hypothesis is accepted that two fleets showed no significant difference in percent of accidents that occurred on deployment.

The fraction of time spent at sea for each CVA was compared with the same frequency for its parent fleet using the likelihood ratio test. The results show that at a .1 level of significance, the time spent at sea by each CVA was consistent with its parent fleet as a whole.

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[illegible]

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423
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Table 2
CVA

	11	38	42	59	60	62	65
Carrier Operating Days	38	197	165	155	241	193	200
Days in Port	22	97	56	58	102	86	83
Percent time at Sea	63.3	67.0	74.7	72.8	70.3	69.2	70.7
Percent time in Port	36.7	33.0	25.3	27.2	29.7	30.8	29.3
Number of Accidents while deployed	0	16	11	11	14	8	10
Number of Accidents/Carrier operating days	.000	.0812	.0667	.0710	.0581	.0415	.0500
Total Number of Accidents	0	25	18	23	18	17	16
Percent of Accidents that occurred on deployment	0	64.0	61.1	47.8	77.8	47.1	62.5

(continued)

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Table 3

	14	16	19	31	34	41	43	61	63	64
Carrier Operating Days	132	118	269	142	193	157	276	165	169	184
Days in Port	76	64	123	76	154	95	159	120	109	96
Percent time at sea	63.5	64.8	68.6	65.1	55.6	62.3	63.5	57.9	60.8	65.7
Percent time in port	36.5	35.2	31.4	34.9	44.4	37.7	36.5	42.1	39.2	34.3
Number of Accidents while deployed	9	6	12	9	10	21	11	11	5	9
Number of Accidents/carrier operating days	.0682	.0508	.0446	.0634	.0518	.1338	.0399	.0667	.0296	.0489
Total number of Accidents	22	9	26	17	20	36	13	17	7	16
Percent of accidents that occurred on deployment	40.9	66.7	46.2	52.9	50.0	58.3	84.6	64.7	71.4	56.3

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7. Distribution of Accidents on Deployment

The period of time during a deployment in which accidents are most likely to occur would be valuable information if it could be accurately predicted. However, many complex variables such as weather, type of operations, proficiency of all involved personnel and many other operating conditions present themselves.

Figs. 4a and 4b represent the deployments for 1962 and 1963 for the CVA's operating with the SIXTH and SEVENTH FLEETS.

In general, most of the accidents occurred within the first two months and gradually declined as the cruise progressed, which is reasonable since the pilots and carrier personnel become more proficient with time. However, a definite rise occurred in both fleets toward the end of the deployment periods. This rise started after about four months for the SEVENTH FLEET and after about six months for the SIXTH FLEET. Sufficient data was not available to accurately account for this rise in accidents. In general, the two fleets appeared to suffer accidents in a similar manner on deployment. The K-S(Kolmogorov-Smirnov) test indicates no significant difference in the cumulative percentage distributions for the two fleets at the .01 level. The largest difference occurred at 180 to 210 days as the number of accidents in the SIXTH FLEET showed a rise where the SEVENTH FLEET showed a slight decrease.

Figs. 5a and 5b show accidents as a function of the number of days at sea since beginning the deployment. Both fleets experienced a mode at less than 20 days, which includes the period enroute to the area of deployment. Other sample modes appear at similar times for the two fleets, but the general pattern decreases with time. It has been shown that the carriers spend between 60 and 70 percent of their deployed time at sea, including the enroute time. For a normal length cruise of six to

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[illegible]

Figure 1 displays a 4x12 grid of small plots, each representing a spatial location. The plots are arranged in four rows (replicates) and twelve columns (species). Each plot contains a black dot indicating the presence of a species or a white circle indicating its absence. The species are numbered 1 through 12, with 1-6 in the first column and 7-12 in the second column. The replicates are numbered 1 through 4 across the rows. The spatial distribution of each species is shown across the four replicates.

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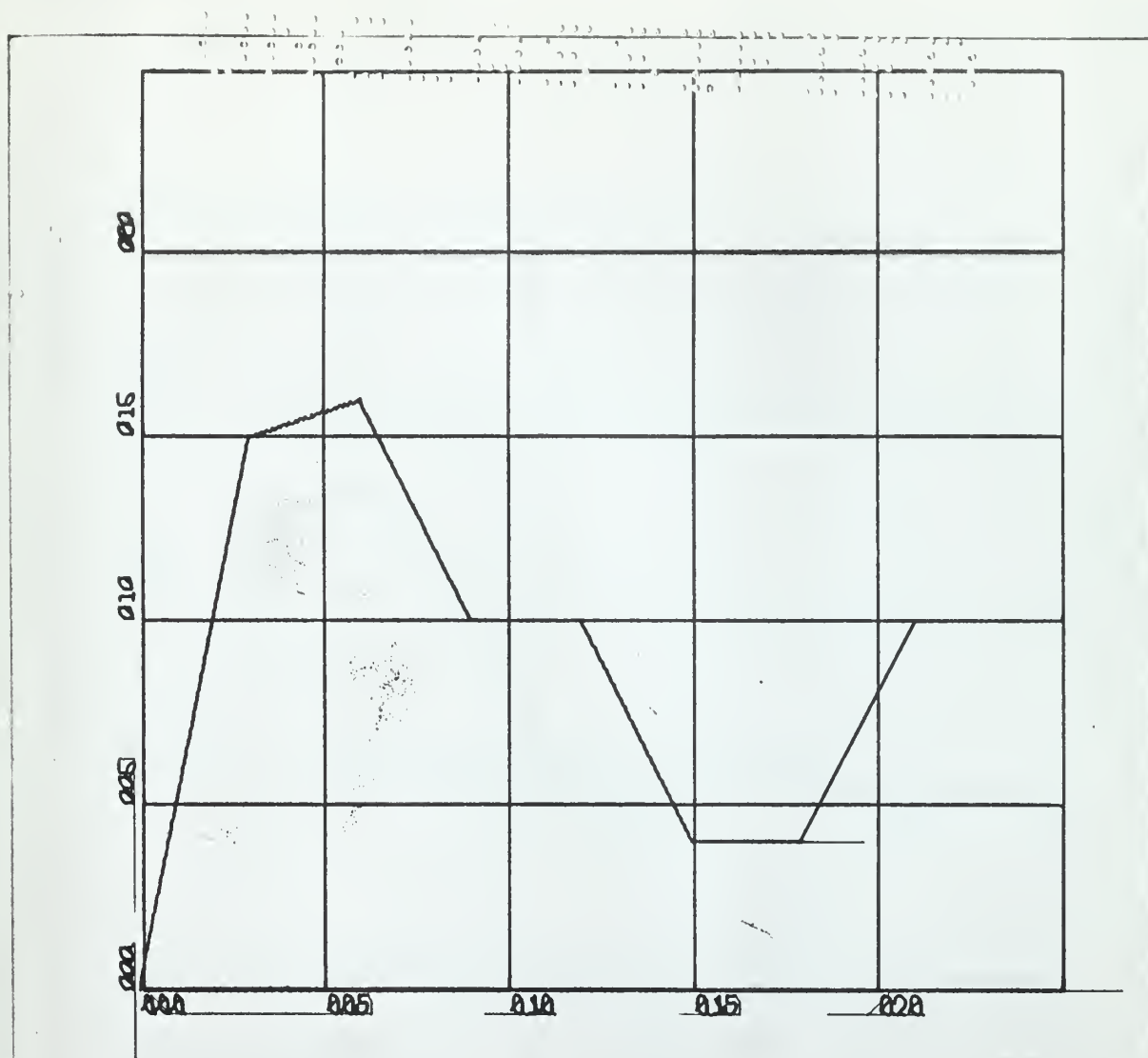
to seven months on station, the cruise would terminate after 120 to 140 operating days. The SIXTH FLEET had a positive rate of accident occurrence during this time, while the SEVENTH FLEET experienced a continued decrease, although at a lesser rate.

The K-S test again shows no difference in the cumulative percentage distributions for the two fleets at the .01 level of significance. The largest difference in the distributions for the two fleets occurred at 120 to 135 days.

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X-Scale=Days x 10

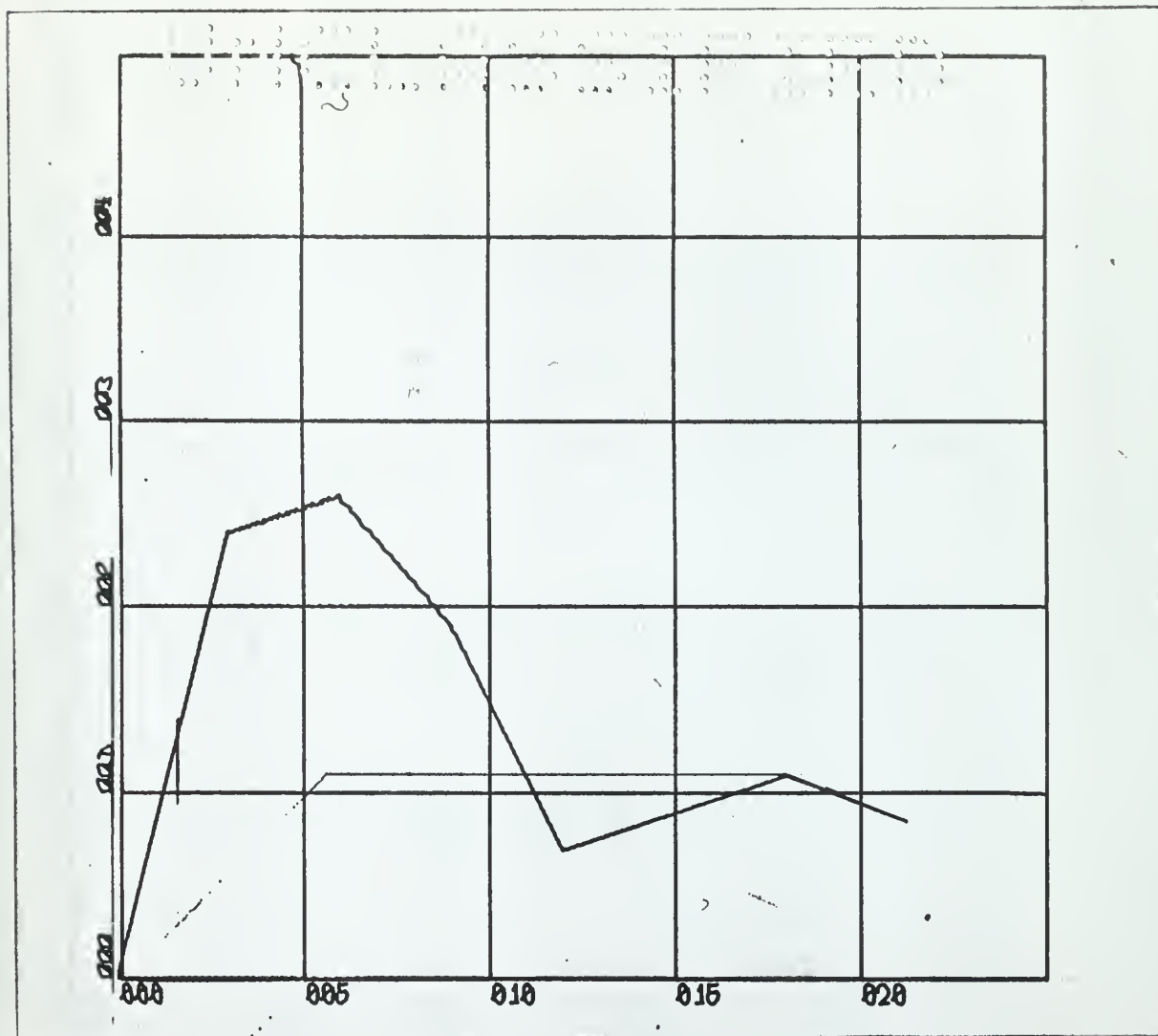
Y-Scale=Accidents

Fig. 4a. Time since beginning of deployment until accident,
6th FLEET

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X-Scale=Days x 10

Y-Scale=Accidents

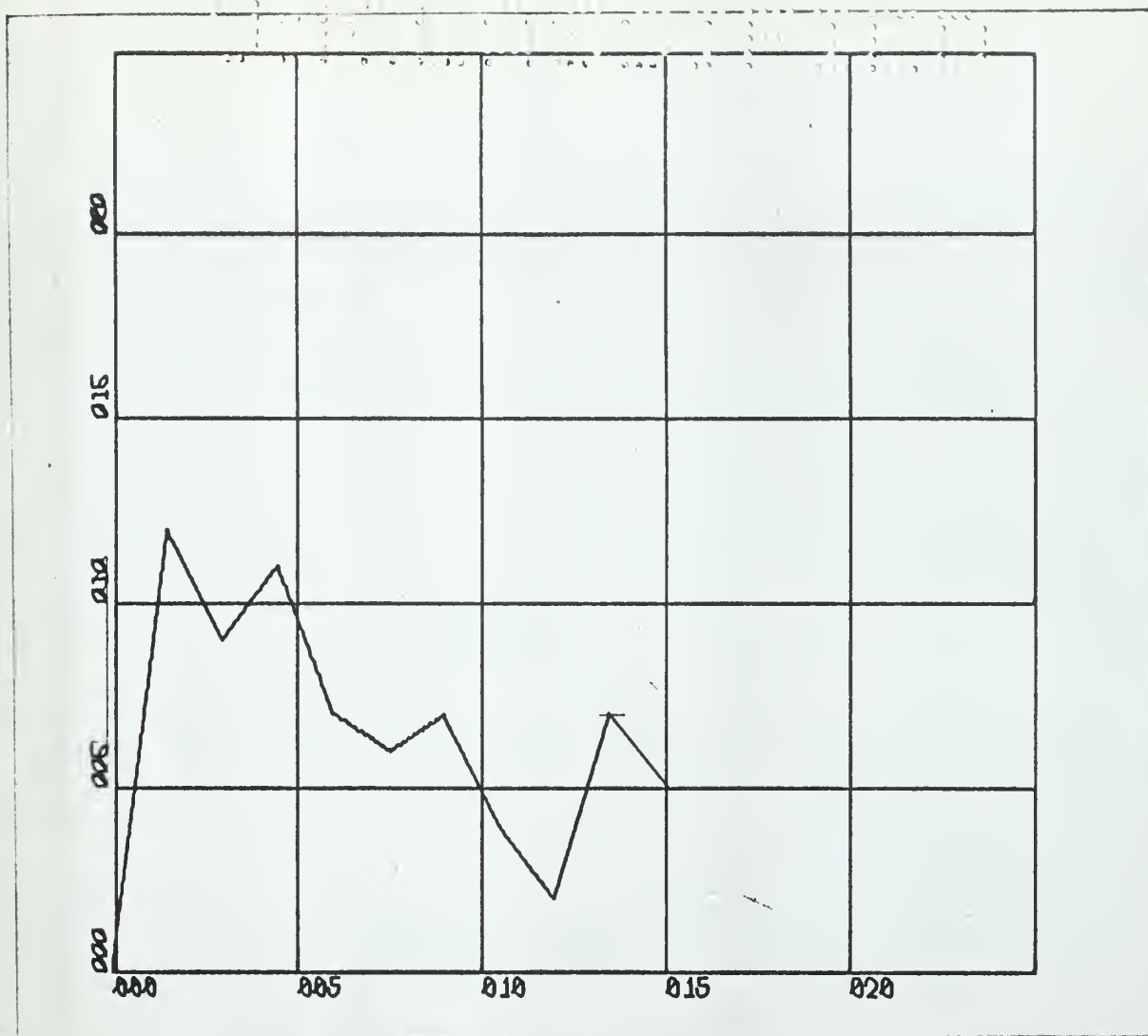
Fig. 4b. Time since beginning of deployment until accident, 7th FLEET.

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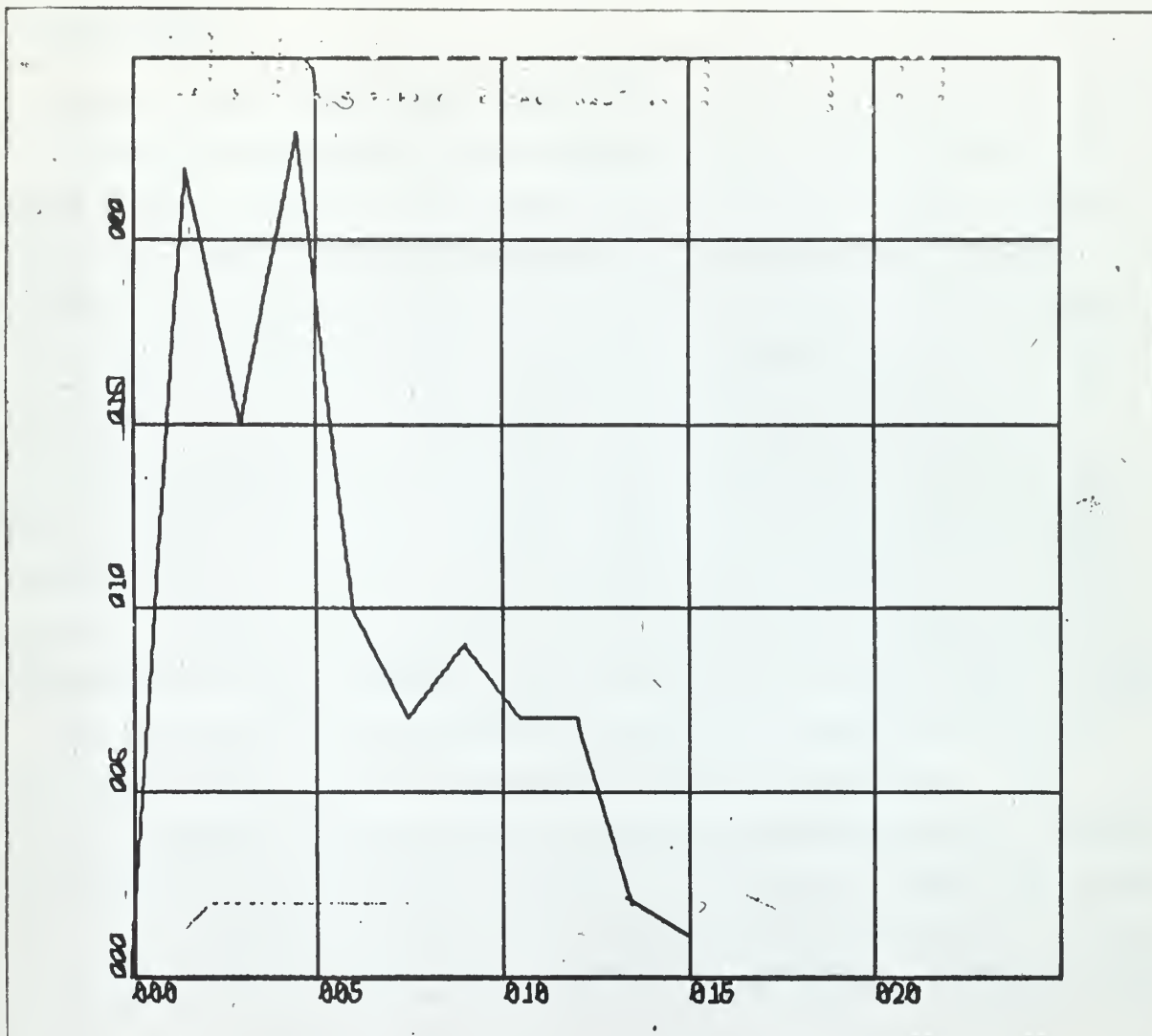
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X-Scale=Days x 10

Y-Scale=2Accidents

Fig. 5a. Time at sea since beginning of deployment until accident, 6th FLEET.



X-Scale=Days x 10

Y-Scale=Accidents

Fig. 5b. Time at sea since beginning of deployment until accident, 7th FLEET.

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8. Length of Time at Sea Prior to Accident

Analysis of the occurrence of accidents during operating periods indicates that most mishaps were recorded within the first five days at sea for both fleets. Fig. 6a shows this frequency of occurrence for the SIXTH FLEET. With an average time spent at sea of 9.59 days, a mode occurred at five days. Afterwards, the rate decreased sharply to ten days and then continued to decrease at a lesser rate. The SEVENTH FLEET, with an average time spent at sea of 9.97 days, also experienced a mode at five days as shown in Fig. 6b. However, almost as many accidents occurred between five and ten days at sea as within the first five days. The distribution of accidents after ten days at sea for both fleets showed a decrease because the number of periods at sea was less than ten days on the average.

The K-S test on the two cumulative distributions showed that the two distributions did not differ significantly at the one percent level. The largest difference occurred during the period from one to five days, with the SIXTH FLEET having the higher percentage. The manner in which flight operations are conducted during the first few days out of port varies with the fleet involved, the length of the in port period, and the particular operating requirements.

In order to examine the effect of the length of in port periods on the number of days out of port until the accident occurred, sample correlation coefficients were calculated for these two variables. If the true nature of accident occurrence were such that the longer a ship remained in port the sooner the accident would occur after putting to sea, the expected correlation should approach -1.0. The calculated correlations do not conform to this theory. The SIXTH FLEET sample correlation coefficient of .408 indicates a positive relationship between length of time in port and length of time at sea prior to an accident. The SEVENTH FLEET sample correlation was -.065. In this case the correlation was negative but was very near zero. For large sample

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sizes, the sample correlation coefficient becomes asymptotically normal. Under this assumption a two tailed test of the hypothesis that the true SEVENTH FLEET correlation is zero resulted in acceptance at the .05 significance level indicating that the two variables may be considered independent. The difference in the two correlation coefficients is partially explained by noting that the distributions of the number of days at sea prior to an accident for both fleets are not significantly different, while the distributions for the length of in port periods were shown to differ at the .01 significance level. However, no intuitive reason is apparent to justify this difference.

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1. The first part of the paper is devoted to the study of the properties of the function $f(x)$ defined by the equation

$$f(x) = \int_0^x \frac{1}{1+t^2} dt, \quad (1)$$

where x is a real number. It is well known that the function $f(x)$ is an odd function and that it is increasing on the whole real line.

2. In the second part of the paper we shall study the properties of the function $f(x)$ defined by the equation

$$f(x) = \int_0^x \frac{1}{1+t^2} dt, \quad (2)$$

where x is a real number. It is well known that the function $f(x)$ is an odd function and that it is increasing on the whole real line.

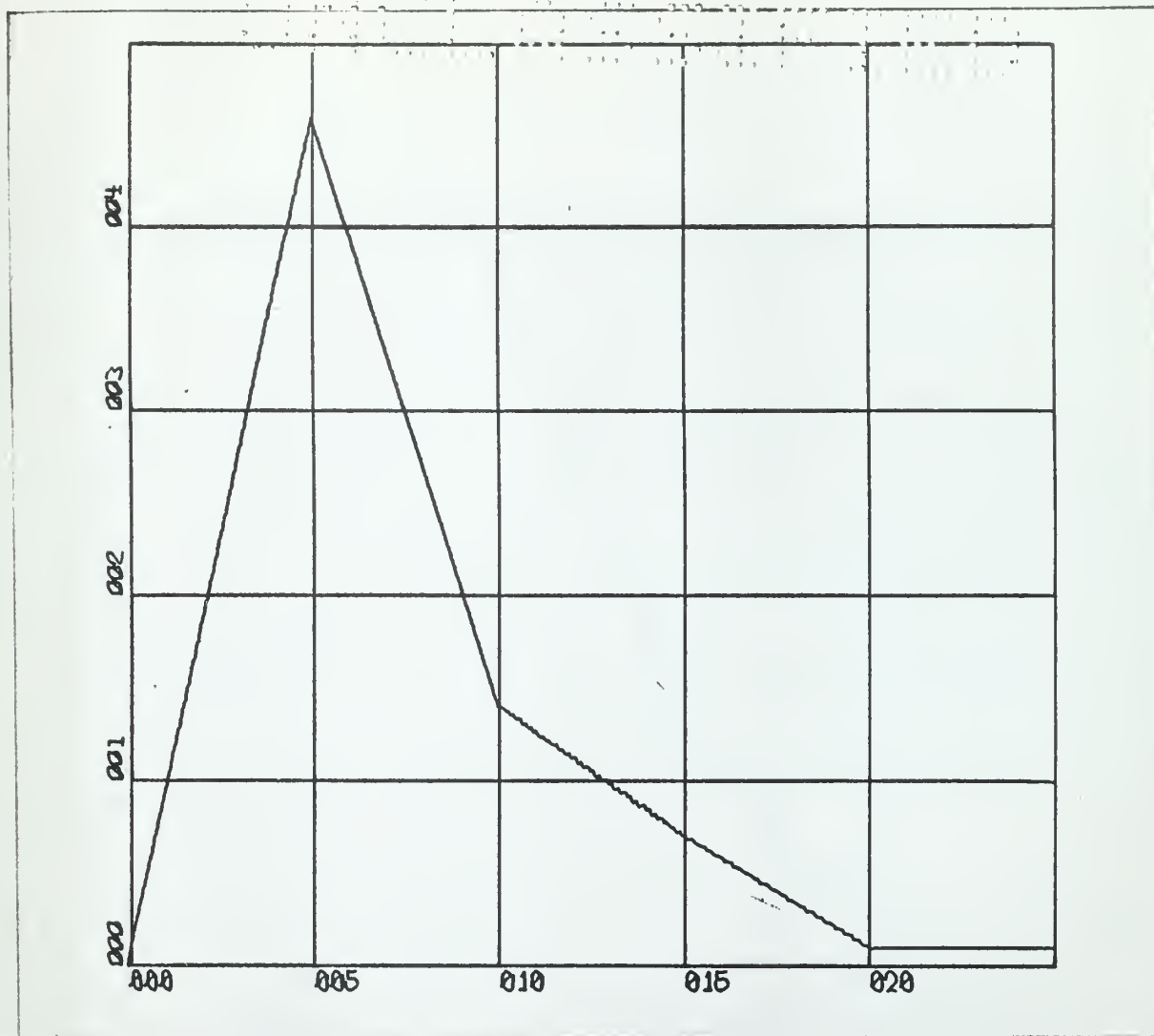
3. In the third part of the paper we shall study the properties of the function $f(x)$ defined by the equation

$$f(x) = \int_0^x \frac{1}{1+t^2} dt, \quad (3)$$

where x is a real number. It is well known that the function $f(x)$ is an odd function and that it is increasing on the whole real line.

1. The first part of the paper is devoted to the study of the properties of the function $f(x)$ defined by the equation

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X-Scale=Days

Y-Scale=Accidents x 10

Fig. 6a. Time at sea immediately prior to accident, 6th FLEET.

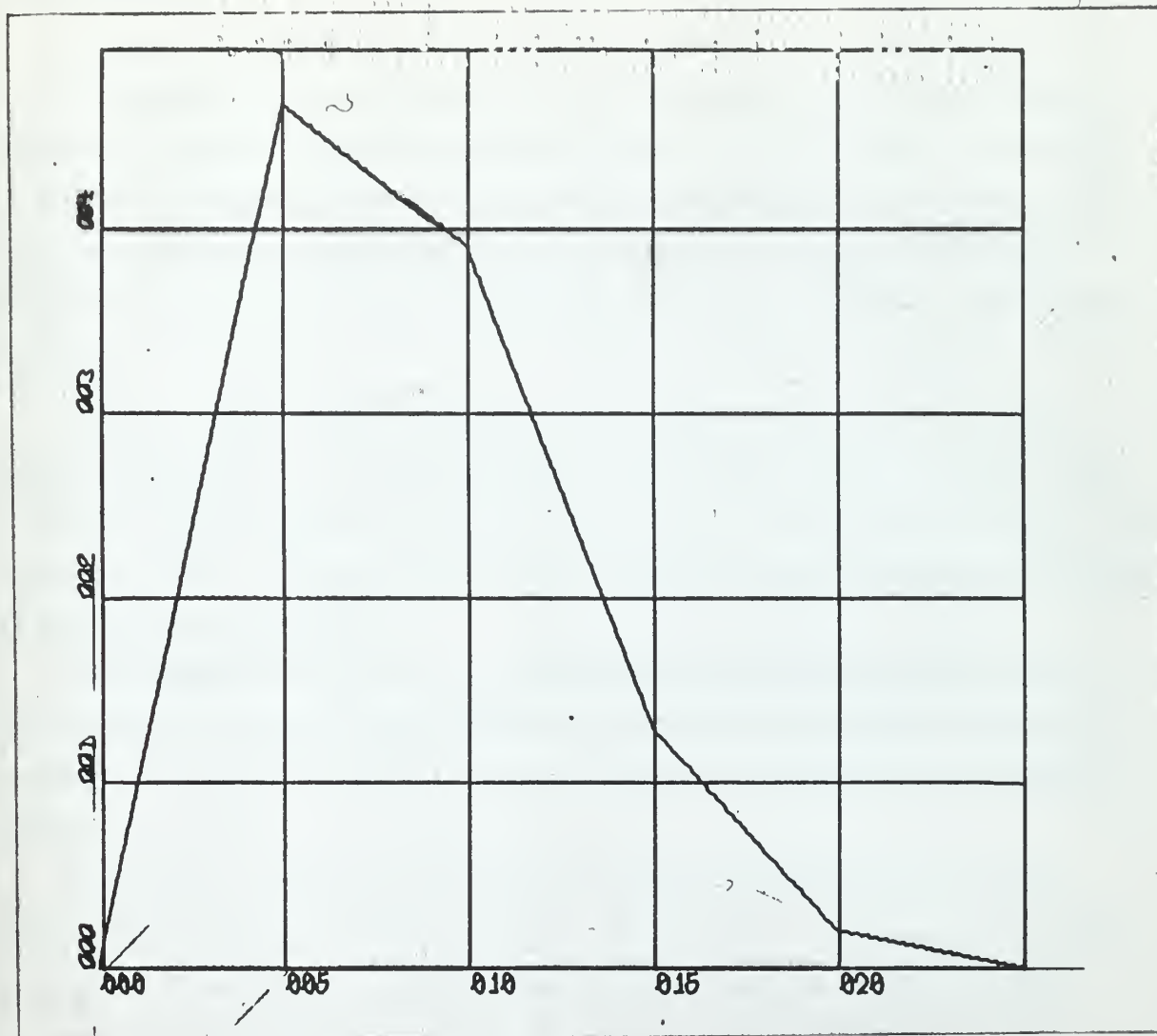
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X-Scale=Days

Y-Scale=Accidents x 10

Fig. 6b. Time at sea immediately prior to accident, 7th FLEET.

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9. Phase of Operation.

A breakdown of aircraft accidents into the phase of operation⁵ during which the accident occurred is shown in Figs. 7a, 7b and 7c. Almost 49% of the 300 combined fleet accidents happened during the landing phase and 60% occurred either during the landing or waveoff. Takeoff and inflight accidents were nearly equal at about 17% each. Fig. 7a shows these distributions.

Of the 70 SIXTH FLEET accidents, the largest number also occurred during landing, Fig. 7b. Thirty-seven percent were landing accidents and 46% were either landing or waveoff, which shows a reduction compared to the combined fleets. However, 27% of the accidents occurred inflight and almost 22% happened on takeoff.

The SEVENTH FLEET, Fig. 7c, followed the same pattern with 48% of the accidents occurring during the landing phase and 64% either landing or waveoff. Takeoff and inflight accidents accounted for 18% and 14% respectively.

In general, most of the accidents occurred during landing with the SIXTH FLEET having the least percent in this phase. The second most common phase of accident occurrence was inflight, and the deployed fleets showed an increase over the combined fleets. Static and taxi phases accounted for approximately 5% in all cases.

In order to compare the fleets a likelihood ratio test was constructed for the combined landing and waveoff phases, which accounted for most of the accidents. The results for the combined fleets and the SIXTH FLEET

⁵U. S. Naval Aviation Safety Center. Manual of Code Classifications for Navy Aircraft Accident, Incident and Ground Accident Reporting, July, 1963: 29-38.

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1. The first part of the document is a list of names and addresses of the members of the committee. The names are written in a cursive hand, and the addresses are written in a more formal, printed hand. The list is organized in a table-like format with columns for names and addresses.

The second part of the document is a list of names and addresses of the members of the committee. The names are written in a cursive hand, and the addresses are written in a more formal, printed hand. The list is organized in a table-like format with columns for names and addresses.

The third part of the document is a list of names and addresses of the members of the committee. The names are written in a cursive hand, and the addresses are written in a more formal, printed hand. The list is organized in a table-like format with columns for names and addresses.

The fourth part of the document is a list of names and addresses of the members of the committee. The names are written in a cursive hand, and the addresses are written in a more formal, printed hand. The list is organized in a table-like format with columns for names and addresses.

The fifth part of the document is a list of names and addresses of the members of the committee. The names are written in a cursive hand, and the addresses are written in a more formal, printed hand. The list is organized in a table-like format with columns for names and addresses.

The sixth part of the document is a list of names and addresses of the members of the committee. The names are written in a cursive hand, and the addresses are written in a more formal, printed hand. The list is organized in a table-like format with columns for names and addresses.

The seventh part of the document is a list of names and addresses of the members of the committee. The names are written in a cursive hand, and the addresses are written in a more formal, printed hand. The list is organized in a table-like format with columns for names and addresses.

The eighth part of the document is a list of names and addresses of the members of the committee. The names are written in a cursive hand, and the addresses are written in a more formal, printed hand. The list is organized in a table-like format with columns for names and addresses.

The ninth part of the document is a list of names and addresses of the members of the committee. The names are written in a cursive hand, and the addresses are written in a more formal, printed hand. The list is organized in a table-like format with columns for names and addresses.

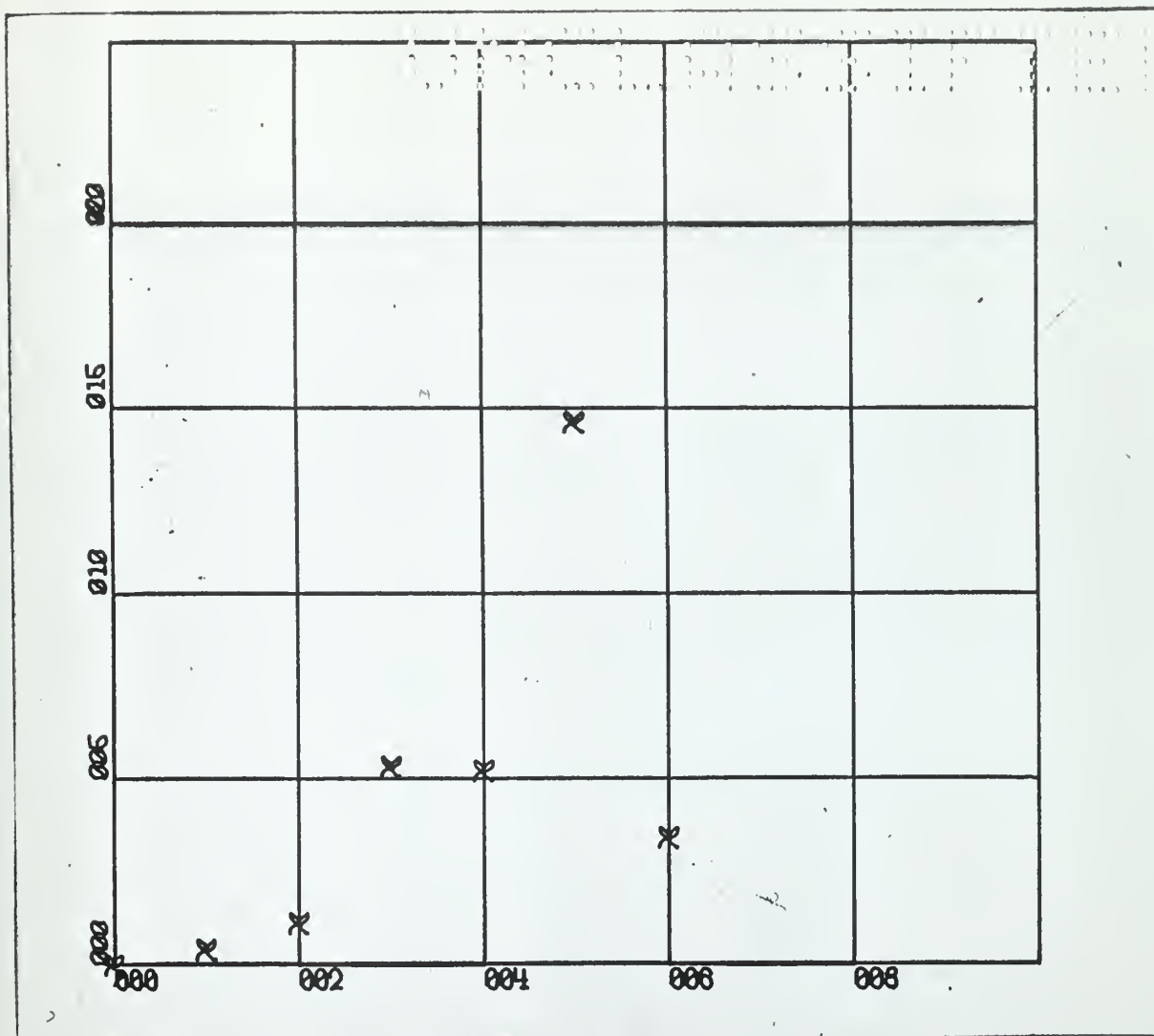
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showed a significant difference at the .05 level with the SIXTH FLEET having the fewer accidents in these phases. The SEVENTH FLEET compared favorably with the combined fleets showing no difference at the .05 significance level. A comparison of the SIXTH and SEVENTH FLEETS showed significant difference at the .05 level with the SIXTH FLEET again having fewer accidents in the landing and waveoff phases.

A comparison of the combined, SIXTH and SEVENTH FLEETS accident phase distributions was made for all the phase types using the two-sample K-S test. Although designed for continuous data, this test is applicable to discrete distributions such as those shown in Figs. 7a, 7b and 7c. [3]. A significant difference exists between the combined fleets and the SIXTH FLEET, and also between the SIXTH FLEET and the SEVENTH FLEET at the .1 level. The phases of maximum difference were inflight, where the SIXTH FLEET had more accidents than the other two, and landing, which showed the SIXTH FLEET with fewer accidents than the SEVENTH FLEET or the combined fleets.

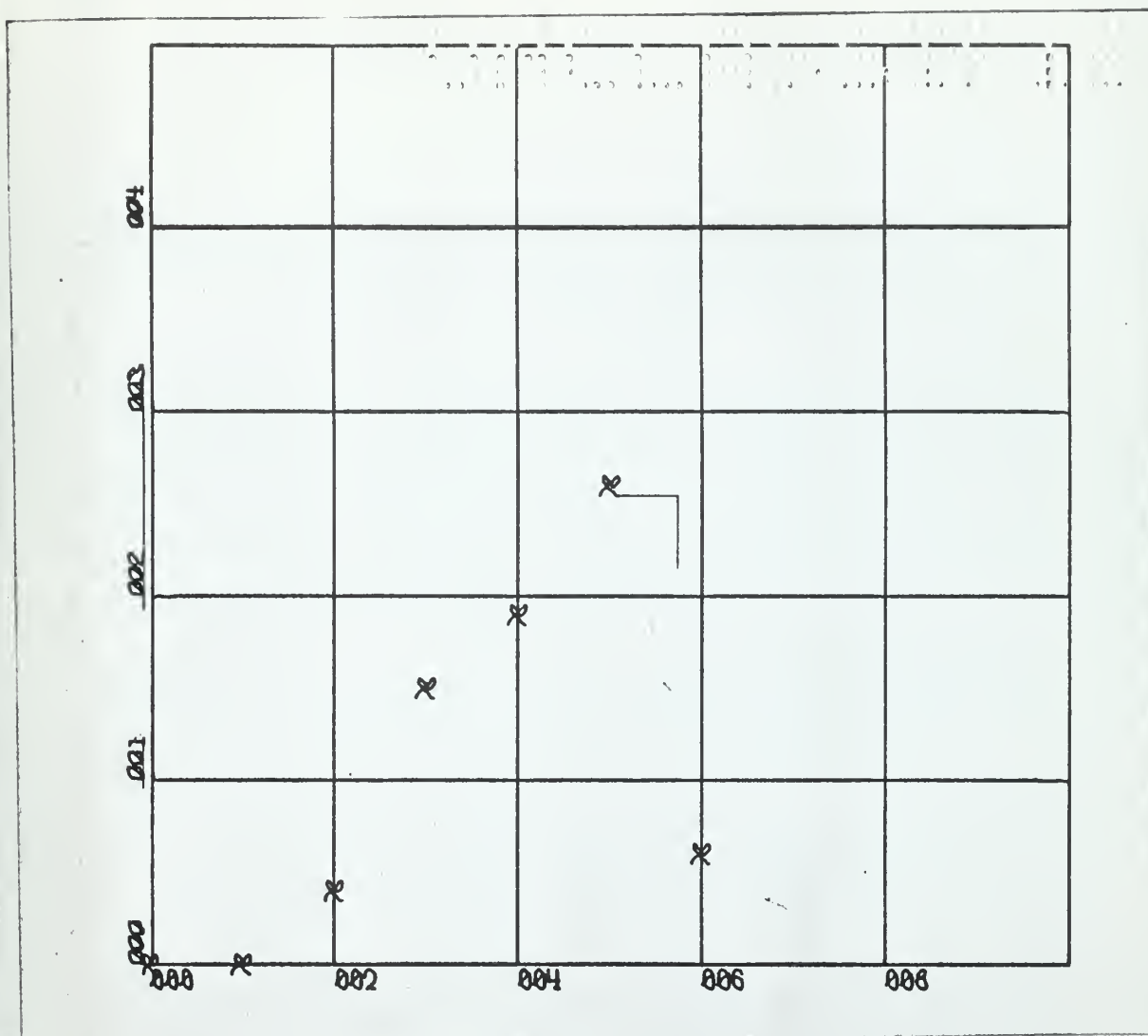
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X-Scale: 0=Undetermined
 1=Static, incident to flight
 2=Taxiing, incident to flight
 3=Takeoff
 4=Inflight
 5=Landing
 6=Waveoff

Y-Scale=Accidents x 10

Fig. 7a. Phase of operation, Combined Fleets.



X-Scale: 0=Undetermined

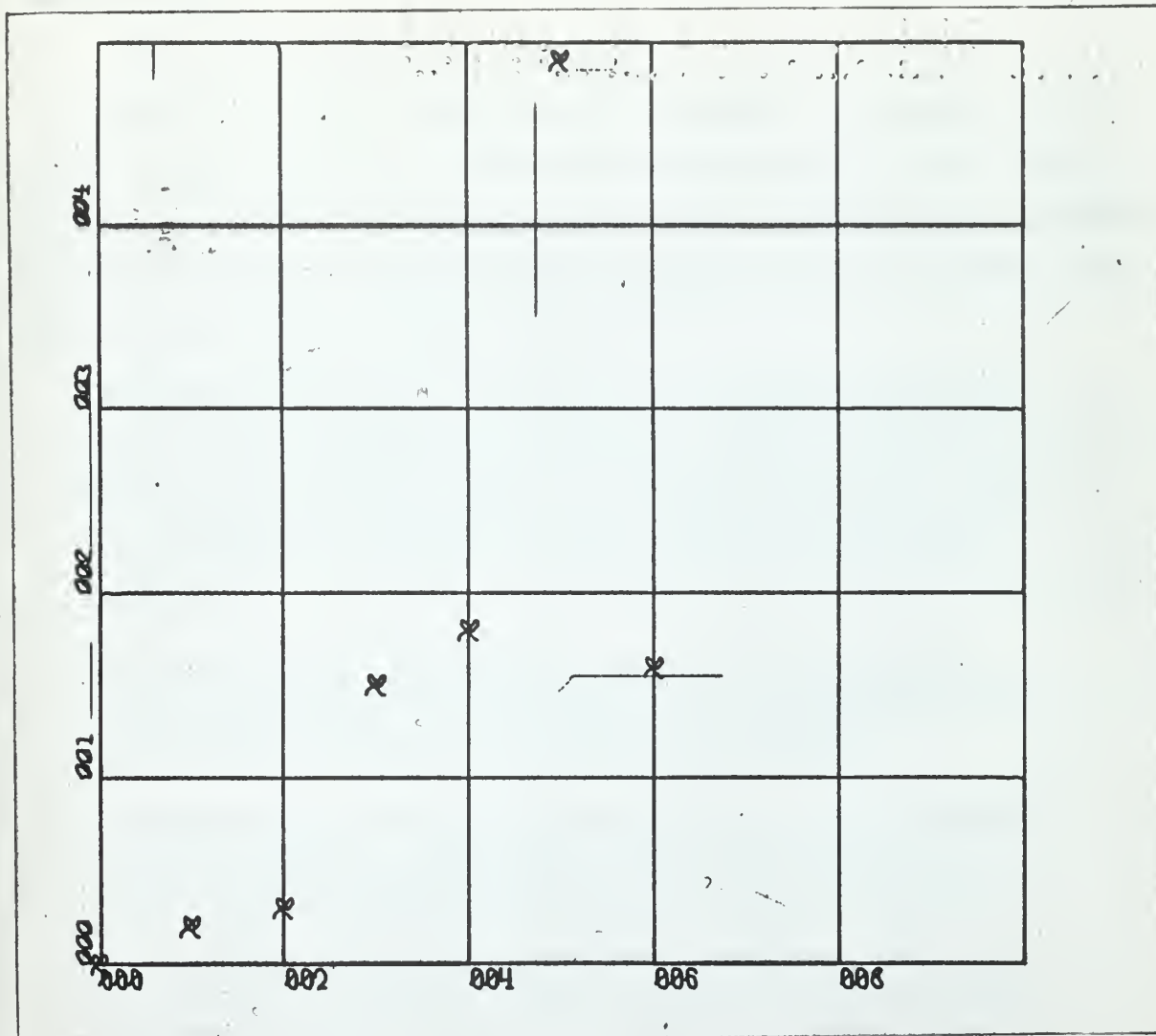
- 1=Static, incident to flight
- 2=Taxiing, incident to flight
- 3=Takeoff
- 4=Inflight
- 5=Landing
- 6=Waveoff

Y-Scale=Accidents x 10⁴

Fig. 7b. Phase of operation, 6th FLEET.

1. The first part of the document is a list of names and their corresponding addresses. The names are listed in the first column, and the addresses are listed in the second column. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.

2. The second part of the document is a list of names and their corresponding addresses. The names are listed in the first column, and the addresses are listed in the second column. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.



X-Scale: 0=Undetermined
 1=Static, incident to flight
 2=Taxiing, incident to flight
 3=Takeoff
 4=Inflight
 5=Landing
 6=Waveoff

Y-Scale=Accident x 10

Fig. 7c. Phase of operation, 7th FLEET

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10. Accident Damage and Cause Factors

Figs. 8a, 8b and 8c present aircraft accidents as a function of pilot injury, aircraft damage and selected cause factors for the various fleets. Fatal injuries are those resulting in death within 30 days after the accident. Unknown injuries are those in which the remains were not recovered. Aircraft accident damage is defined as follows⁶:

ALFA-Destruction, loss or damage to the aircraft which renders the aircraft of no further value except for possible salvage of parts. . . This classification does not include repairable aircraft which must be surveyed because of inaccessible location, current limitations on manhours or funds allowable for the repair of the aircraft, or aircraft is stricken for other administrative reasons.

BRAVO-Aircraft damage sustained which is so extensive that a standard rework at an O & R facility or at a contractor's plant is necessary to restore the aircraft to serviceability.

CHARLIE-Aircraft damage sustained which does not necessitate a standard rework. . . when (1) The total direct manhours required to effect complete repairs to the aircraft exceeds the minor damage limits established for the various models of aircraft as listed in enclosure (5) of (OPNAVINST 3750.6E). (2) Destruction or damage beyond economical repair to a major component requiring its removal and replacement with a new component.

During the two year span of this study, 69 accidents in the combined fleets resulted in fatal or unknown injuries. Thirty three percent of these occurred in the SIXTH FLEET and 35% in the SEVENTH FLEET. One accident in three resulted in fatality in the SIXTH FLEET while the SEVENTH FLEET suffered one in four on the average.

⁶U.S. Naval Aviation Safety Center. Manual of Code Classifications for Navy Aircraft Accident, Incident and Ground Accident Reporting, July, 1963:3.

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Aircraft damage for each of the fleets shows BRAVO damage a loss frequent classification in all cases. The K-S test of the cumulative percentage distributions for accident classification resulted in no significant difference in the combined fleets and the SEVENTH FLEET at the .1 level. However, the SIXTH FLEET was significantly different when compared to the combined fleets or the SEVENTH FLEET at this level.

Pilots were listed as contributing cause factors in almost half the accidents for each of the fleet categories. This indicates pilot's actions contributed to the occurrence and extent of damage, and that they were not necessarily the sole causal factor. However, these high percentages indicate an area which could substantially lower the number of accidents if the pilot factor were reduced.

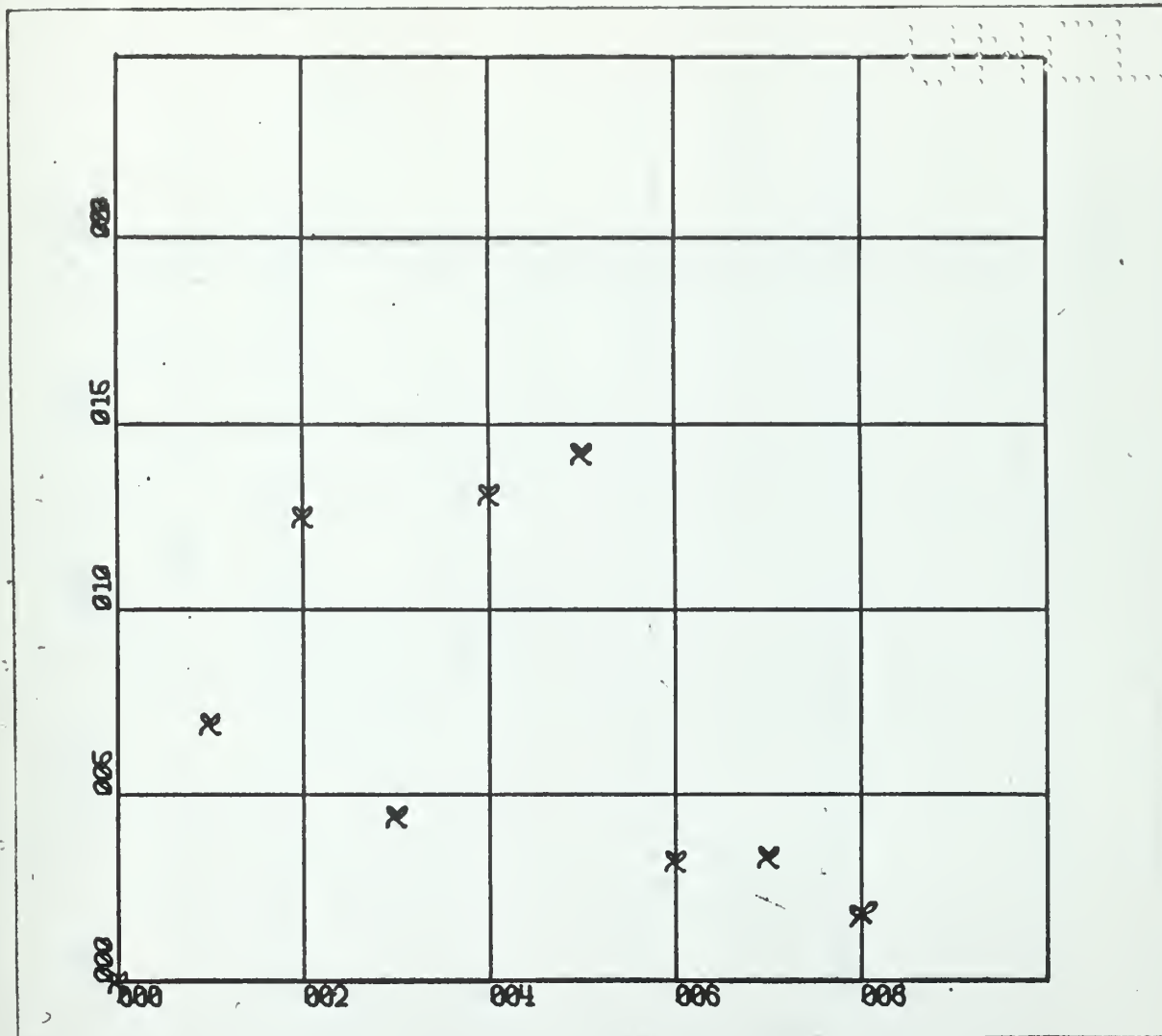
The extent of ship participation in accident causation was examined in three categories. It was found that the LSO was listed as a contributing cause factor in 11% of the combined fleet accidents, 13% for the SEVENTH FLEET and 7% for the SIXTH FLEET. The CVA was reported as a contributing factor in 12% of the combined fleet accidents, 13% for the SEVENTH FLEET and 9% for the SIXTH FLEET. No significant differences existed in these areas between the two deployed fleets or the combined fleets at the .1 level. Pitching deck was a cause factor in 6% of the combined fleet accidents, 8% of the SEVENTH FLEET, and none of the SIXTH FLEET accidents. Sufficient data was not available for a comparison of the total amount of operations which were conducted under conditions involving pitching decks and any conclusions concerning a fleet's performance under these conditions would not be factual.

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THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. From the first settlers to the present day, the nation has evolved through various stages of development. The early years were marked by exploration and settlement, followed by a period of rapid expansion and industrialization. The American Revolution was a pivotal moment in the nation's history, leading to the establishment of a new government. The 19th century was a time of great achievement, with the United States becoming a world power. The 20th century brought new challenges, including the Great Depression and World War II. Today, the United States continues to grow and change, facing new opportunities and challenges.

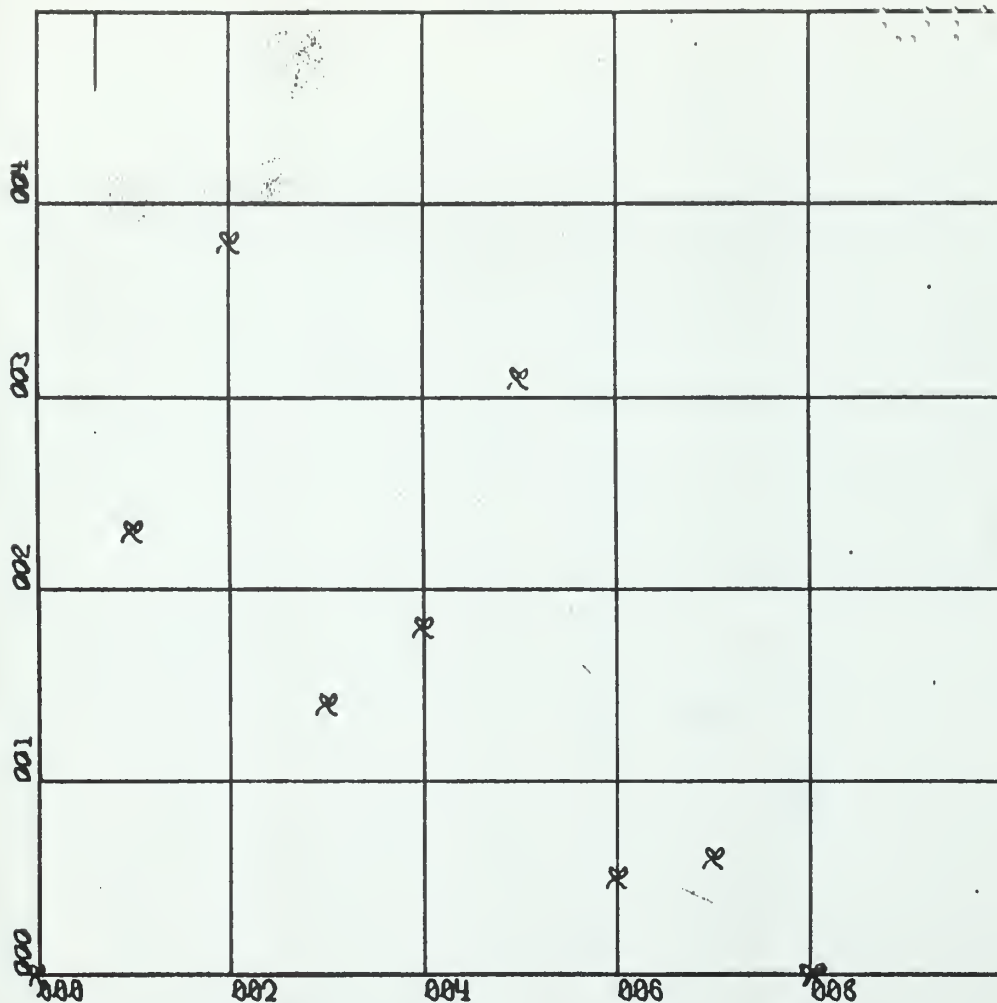
The history of the United States is a story of growth and change. From the first settlers to the present day, the nation has evolved through various stages of development. The early years were marked by exploration and settlement, followed by a period of rapid expansion and industrialization. The American Revolution was a pivotal moment in the nation's history, leading to the establishment of a new government. The 19th century was a time of great achievement, with the United States becoming a world power. The 20th century brought new challenges, including the Great Depression and World War II. Today, the United States continues to grow and change, facing new opportunities and challenges.



X-Scale: 1=Fatalities or unknowns
 2=ALFA damage
 3=BRAVO damage
 4=CHARLIE damage
 5=Pilot as a cause factor
 6=LSO as a related variable
 7=CVA as a contributing cause factor
 8=Pitching deck as a contributing cause factor

Y-Scale=Accidents x 10

Fig. 8a. Damage and cause factors, Combined Fleets.

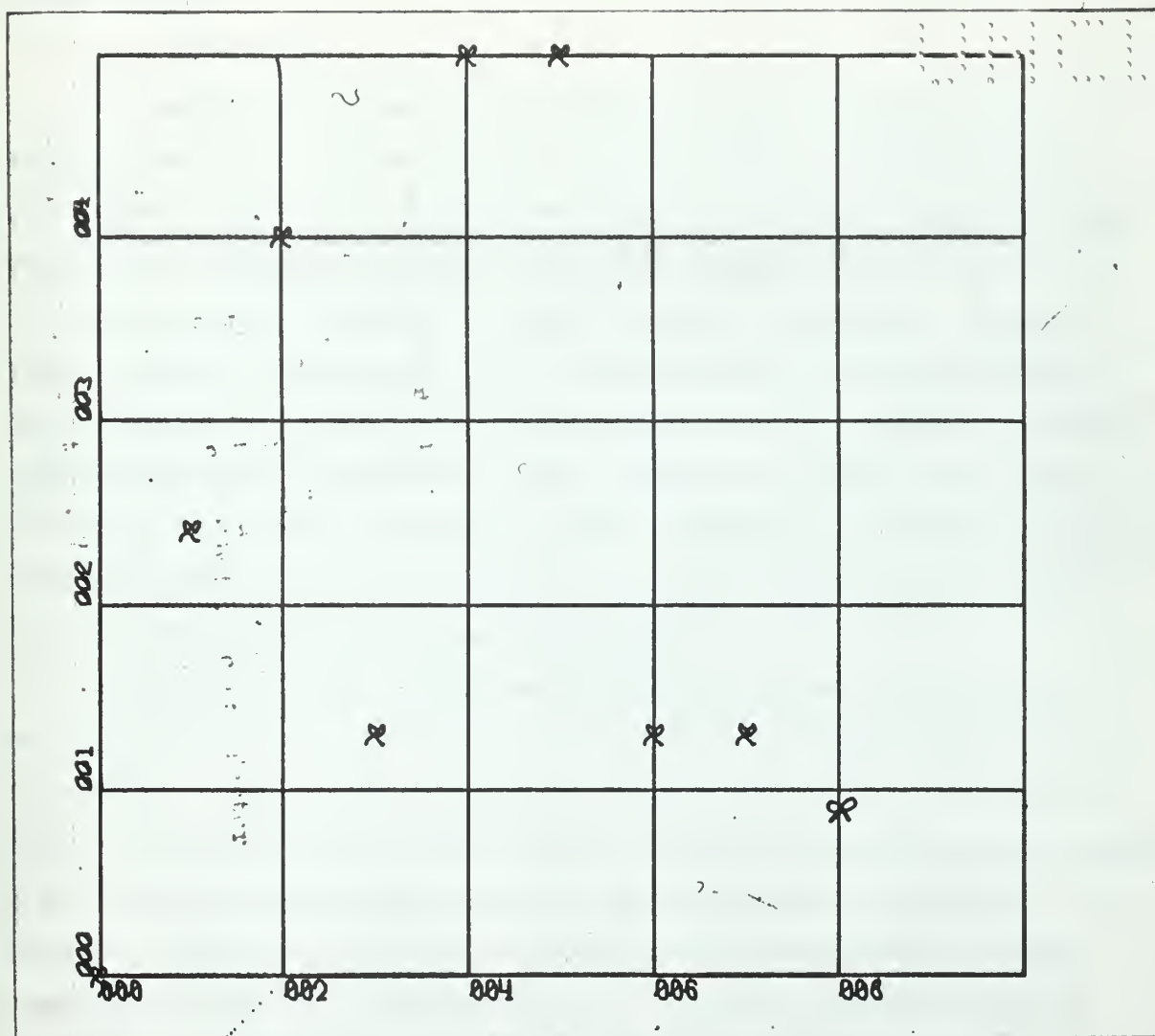


X-Scale: 1=Fatalities or unknowns
 2=ALFA damage
 3=BRAVO damage
 4=CHARLIE damage
 5=Pilot as a cause factor
 6=LSO as a related variable
 7=CVA as a contributing cause factor
 8=Pitching deck as a contributing cause factor

Y-Scale=Accidents x 10

Fig. 8b. Damage and cause factors, 6th FLEET

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X-Scale: 1=Fatalities or unknowns
 2=ALFA damage
 3=BRAVO damage
 4=CHARLIE damage
 5=Pilot as a cause factor
 6=LSO as a related variable
 7=CVA as a contributing cause factor
 8=Pitching deck as a contributing cause factor

Y-Scale=Accidents x 10

Fig. 8c. Damage and cause factors, 7th FLEET.

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11. Total Pilot Time.

The variable discussed in this section and those of the remaining sections have been studied for many years by NASC and are included in their annual report which displays the fleetwide picture of aircraft accident occurrence. They are of prime importance in depicting the proficiency and operational experience levels of pilots involved in accidents. However, these variables are members of a set of data which has been subjected to much analysis in the past. They have served a useful purpose in providing valuable information to initially reduce the Navy's aircraft accident rate. At the present, however, the easy and obvious remedies for accident causation have been taken, and these variables do not yield the subtle and hidden cause factors unless their values are extreme.

The frequency of total pilot time for pilots involved in CVA accidents during 1962 and 1963, Figs. 9a, 9b and 9c, shows a similar trend for each of the fleets. The curves rise sharply to the largest mode at 800 and 900 hours since most of the aviators flying from CVA's on their first tour of operational duty have accumulated approximately this amount of pilot time. In addition, these first tour pilots in general lack the experience and proficiency that comes with subsequent tours. The curves decrease after the first mode, resembling the pattern of rotation of these first sea tour pilots to their first shore duty which rarely involves carrier flying. Therefore a drop in accidents involving aviators with about 1500 pilot hours is to be expected. The SEVENTH FLEET differed slightly in that the decrease from the first mode covered a wider range of pilot hours. The second mode represents pilots on their second tour of carrier flying and occurred at slightly less than 2000 hours. The number of accidents represented by this mode is less than the first mode since aviators in this class are usually more experienced in carrier flying. The data as presented here represents only those aviators who had accidents, but it is suspected that a plot of total pilot hours for all CVA pilots would show modes at approximately the same locations.

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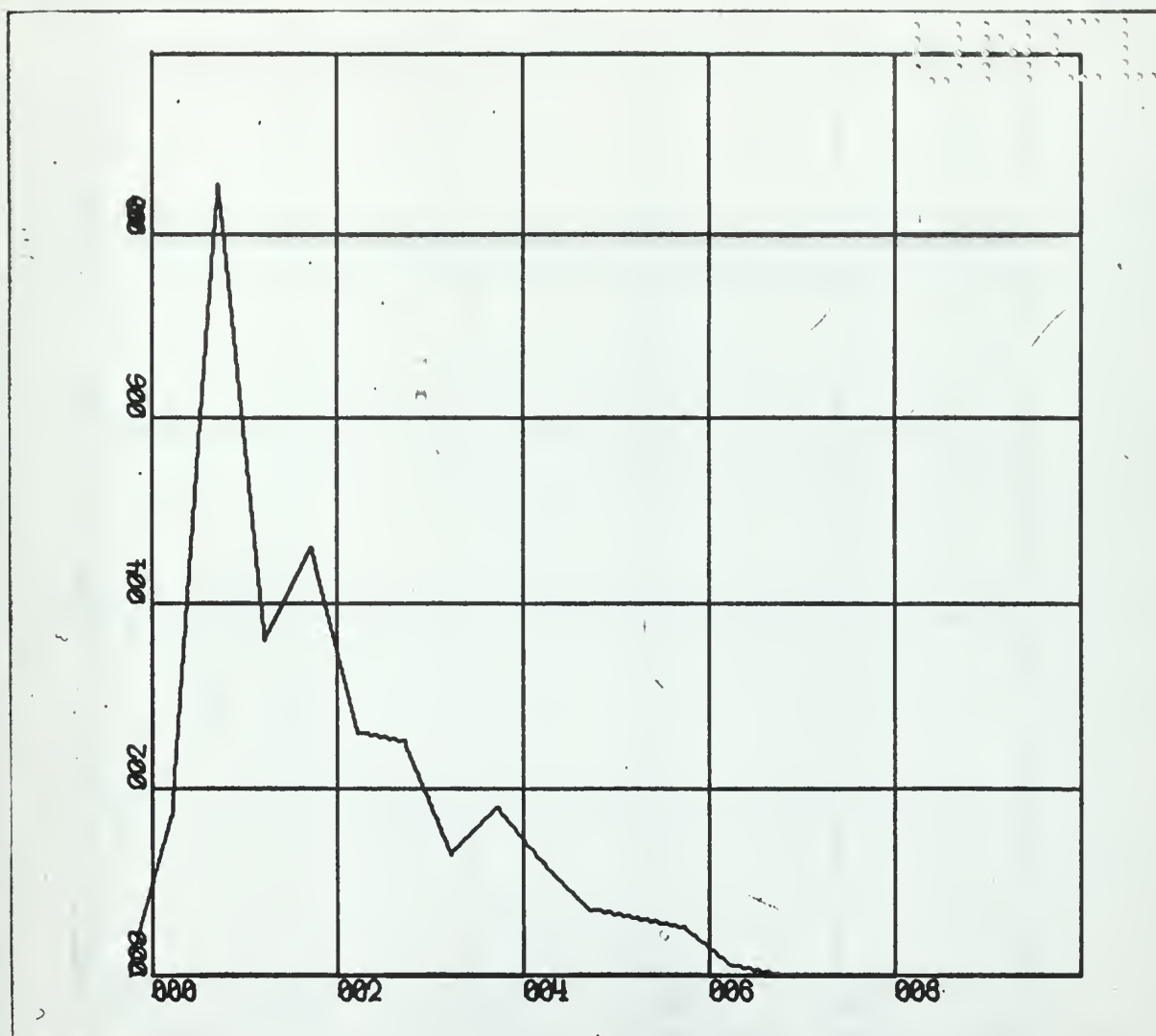
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Total pilot time was analyzed for 1962 and 1963 separately. The cumulative percentage distributions showed no significant difference in the two years at the .1 level when subjected to the K-S two sample test. Each of the fleet categories were also tested against the others at the .1 level and no difference was found to exist.

No data was obtained for pilots who were not involved in accidents. However, under the hypothesis that total pilot time for these aviators is not significantly different from the data shown in Figs. 9a, 9b and 9c, it can be concluded that total pilot time for aviators involved in accidents is a representative sample from the total population of aviators who fly from CVA's. Therefore, this variable does not appear to be useful in a discriminatory analysis where the objective is to determine functions of certain discriminating variables which will lead to prediction of accidents.

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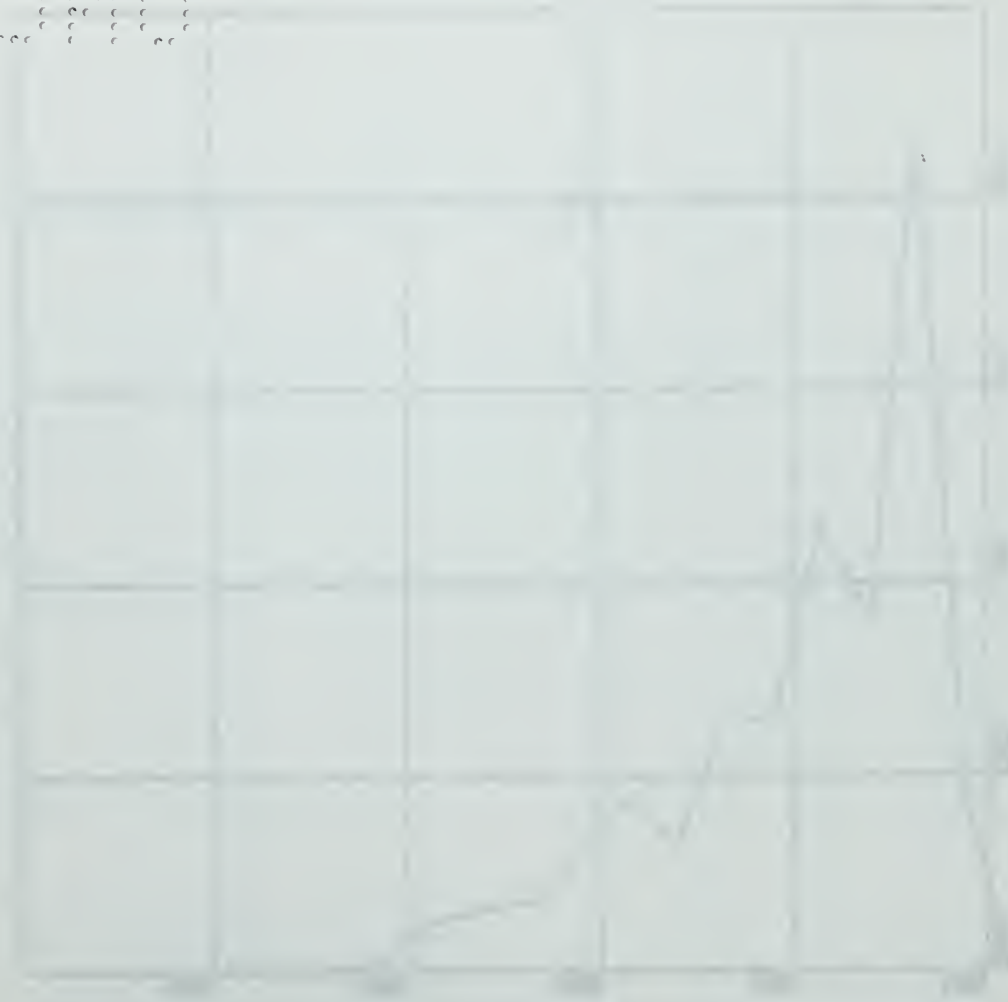


X-Scale=Hours x 1000

Y-Scale=Accidents x 10

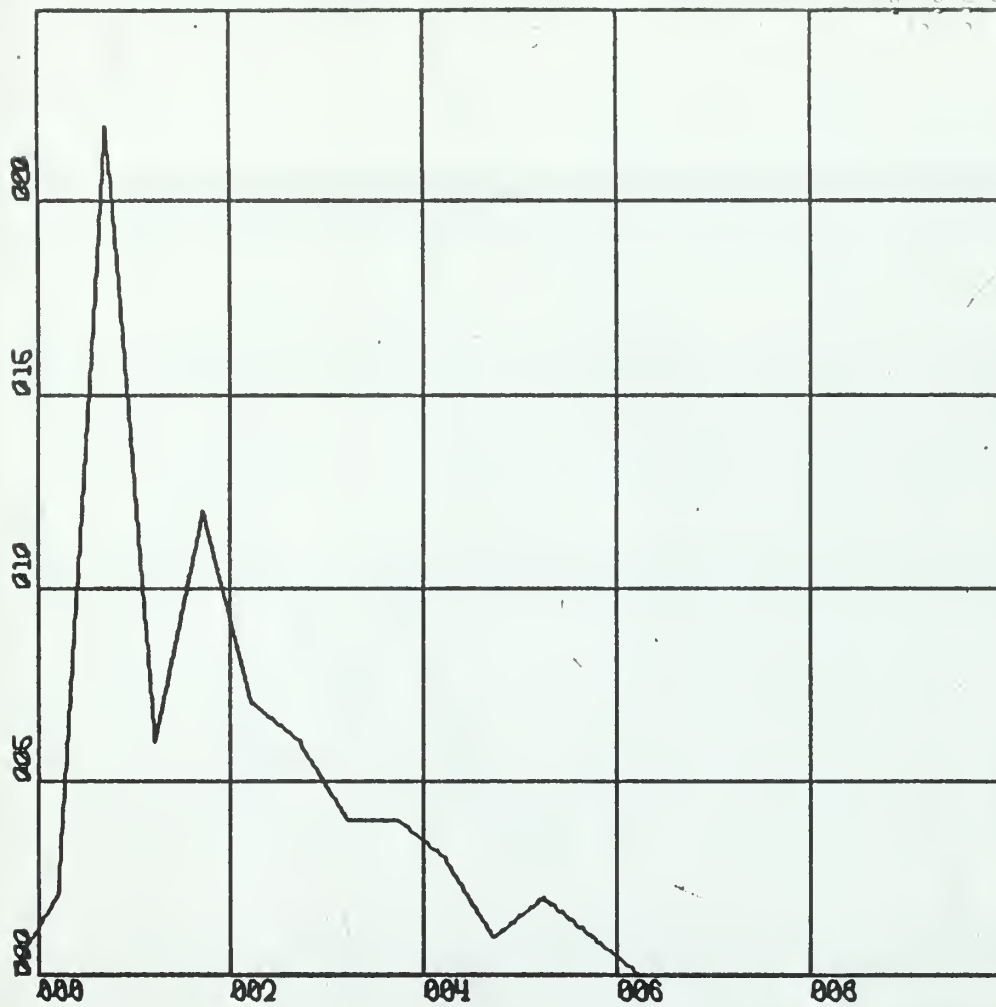
Fig. 9a. Total pilot time, Combined Fleets

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100



The graph shows the relationship between the number of hours worked and the amount of money earned. The curve starts at the origin, rises to a peak, and then falls. The peak of the curve is labeled 'A'.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

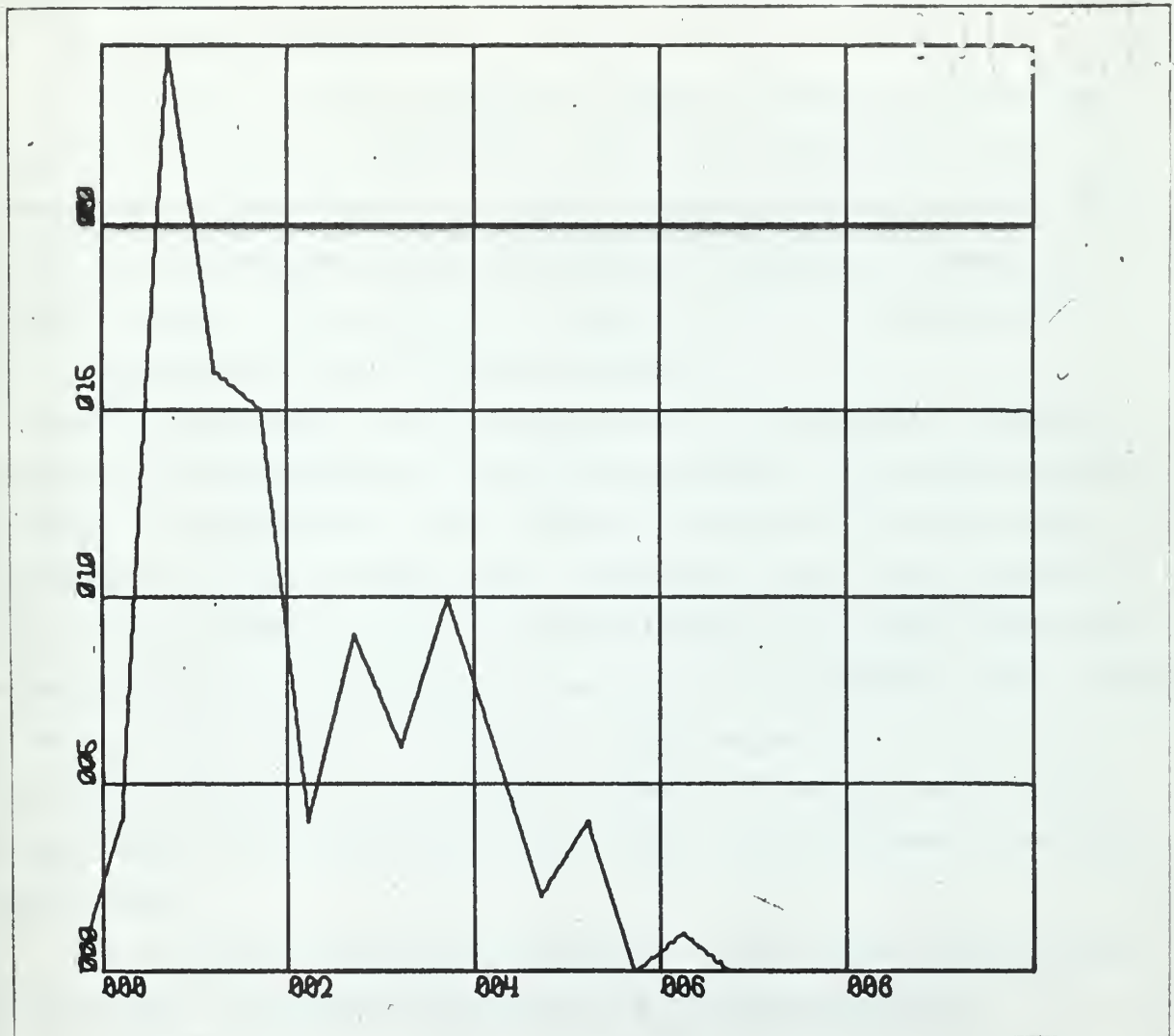


X-Scale=Hours x 1000

Y-Scale=Accidents

Fig. 9b. Total pilot time, 6th FLEET

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X-Scale=Hours x 1000
Y-Scale=Accidents

Fig. 9c. Total pilot time, 7th FLEET.

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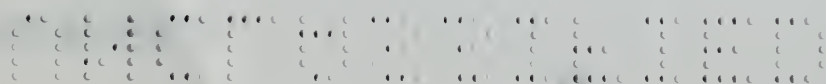
12. Years Military Flying.

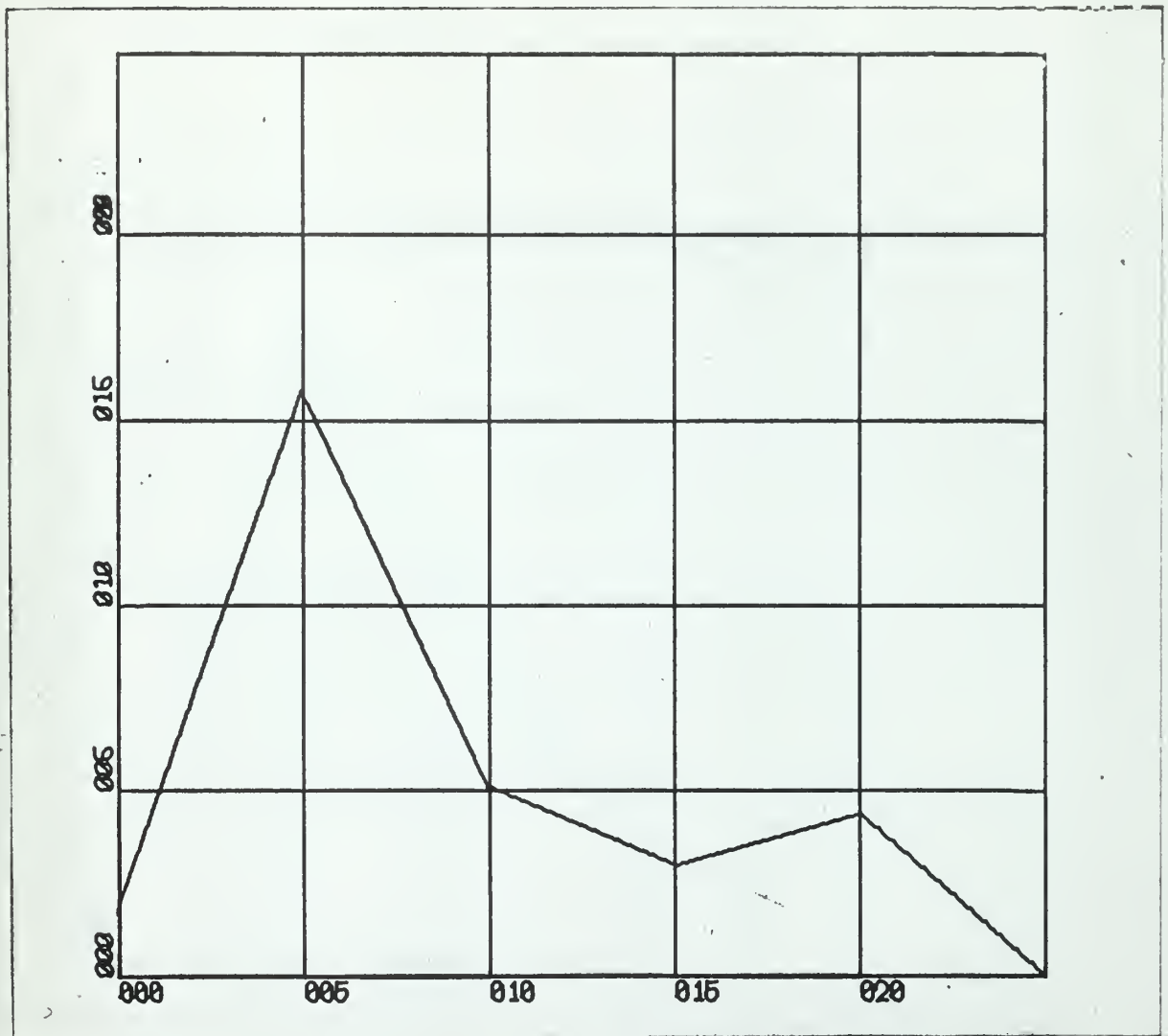
The number of aircraft accidents is shown as a function of years military flying in Figs. 10a, 10b and 10c. This data as collected by the U. S. Naval Aviation Safety Center is recorded in integer increments through the ninth year. Otherwise it is coded in classes of 10 through 14 years, 15 through 20 years and over 20 years. Because of this data classification, some interpretations of the graphs is necessary.

As was pointed out for total pilot time, most of the accidents involved pilots with approximately five years flying experience. The number then decreased as these first tour pilots rotated to shore duty. This covers the period through about the tenth year. Other modes should appear between 10 and 15 years, however, both the combined fleets and the SIXTH FLEET show a continued decrease, although at a lesser rate. The SEVENTH FLEET showed a rise during this period. All fleets are characterized by a second mode at 20 years which should be interpreted as between 15 and 20 years. Integer classification of the data through all the years would have made these plots more precise.

The cumulative percentage distributions for each of the fleets did not differ at the .1 significance level under the K-S two sample test.

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X-Scale=Years

Y-Scale=Accidents x 10

Fig. 10a. Years military flying, Combined Fleets.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

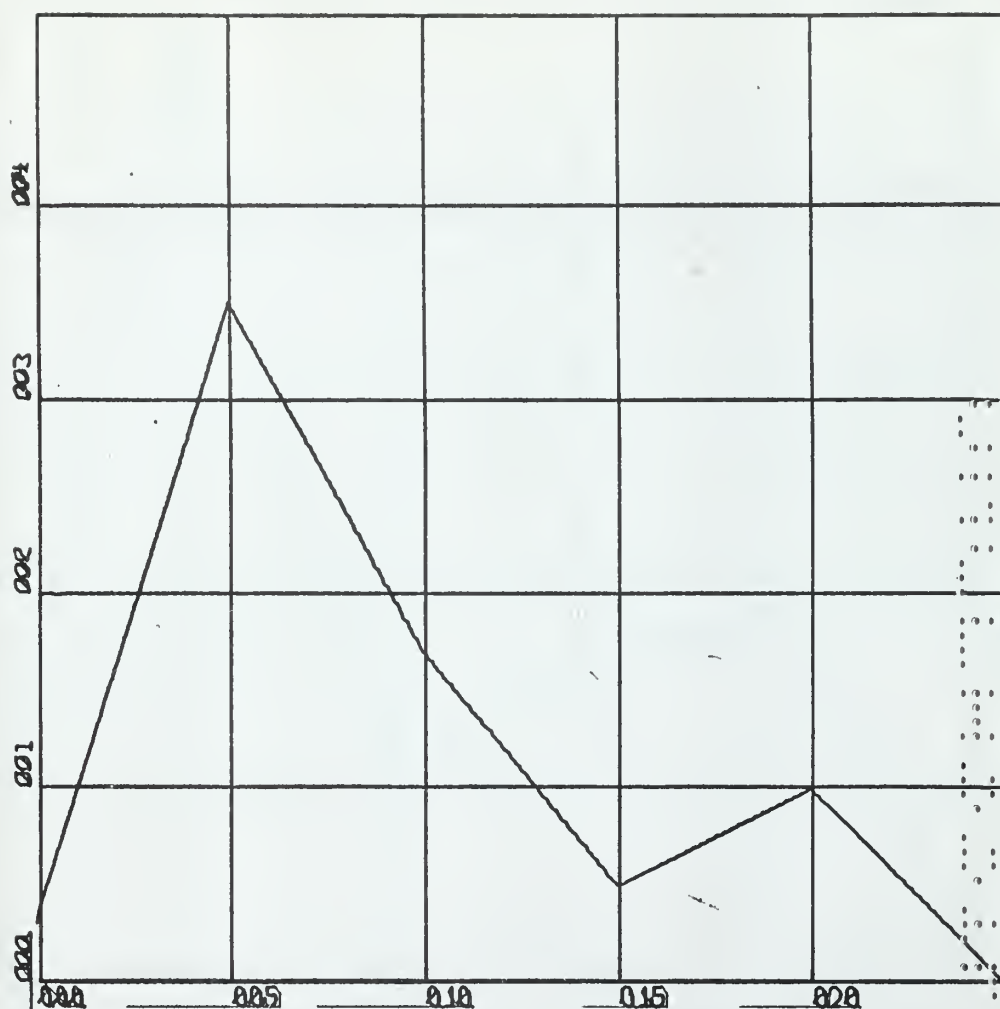


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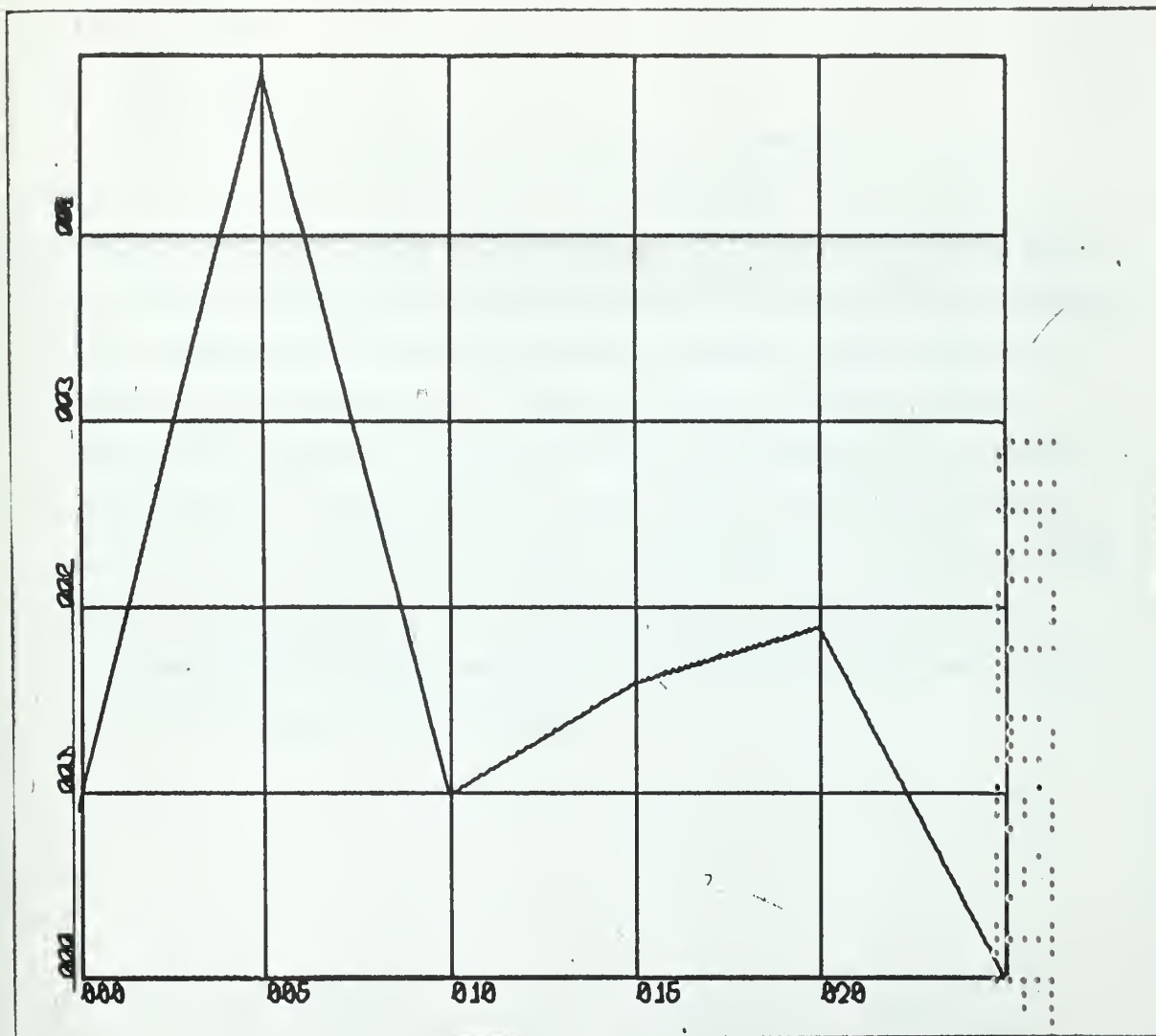
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X-Scale=Years

Y-Scale=Accidents x 10

Fig. 10b. Years military flying, 6th FLEET.



X-Scale=Years

Y-Scale=Accidents x 10

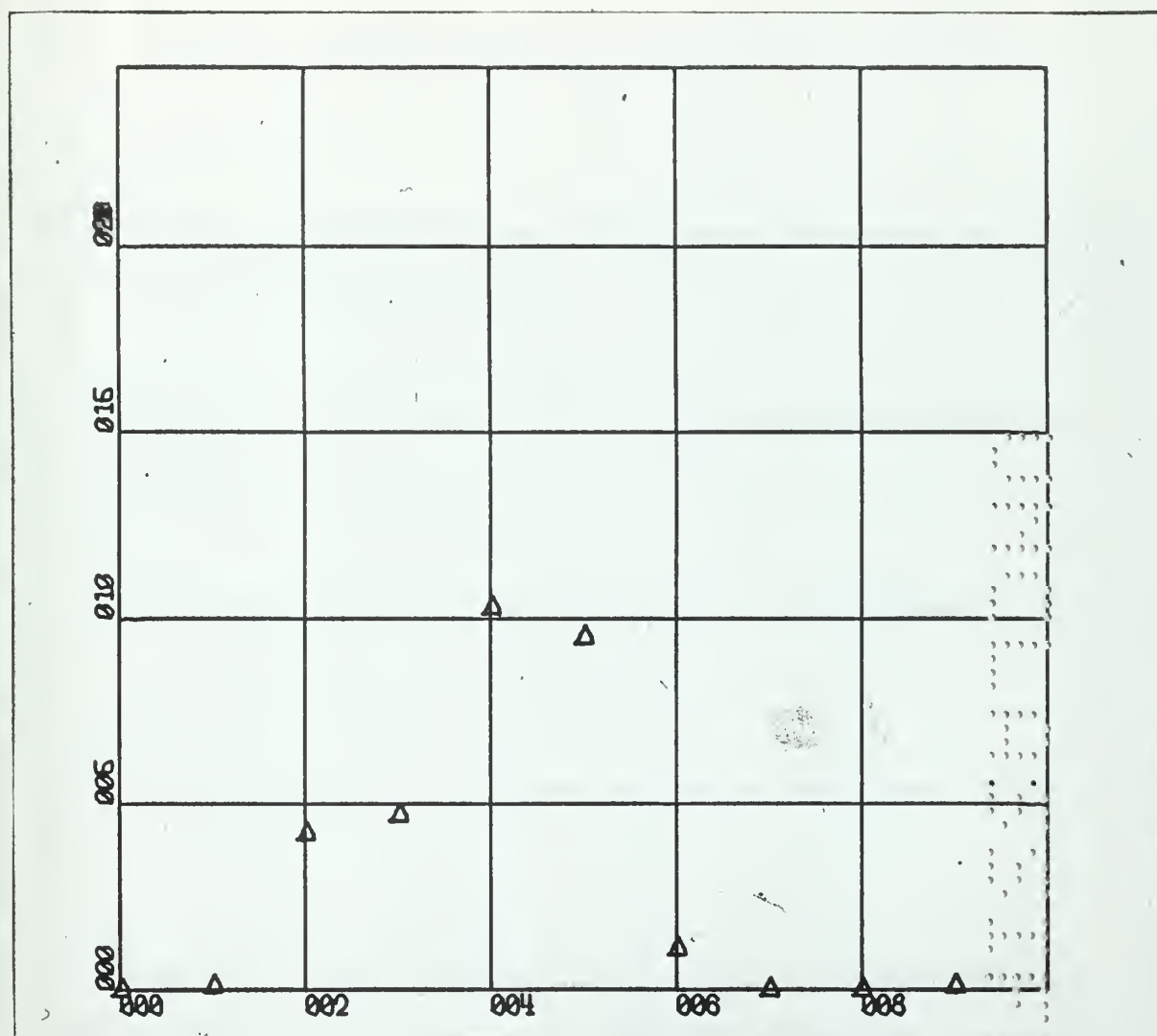
Fig. 10c. Years military flying, 7th FLEET.

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13. Pilot's Rank.

Analysis of the number of accidents as a function of the rank of the pilot follows the general pattern established by the plots of total pilot time and years military flying. Figs. 11a, 11b and 11c show that most of the accidents involved pilots of the ranks of LT and LTJG, which correspond to the modes at about 1000 pilot hours and one to five years flying experience. The rank groups of LCDR and CDR show fewer accidents, as did the curves for corresponding total pilot hours and years military flying. Again, the rank of pilots involved in accidents seems to follow the suspected distribution of pilots assigned to flying billets aboard CVA's. One exception appears in Fig. 11c, where the SEVENTH FLEET recorded more commanders involved in accidents than lieutenant commanders.

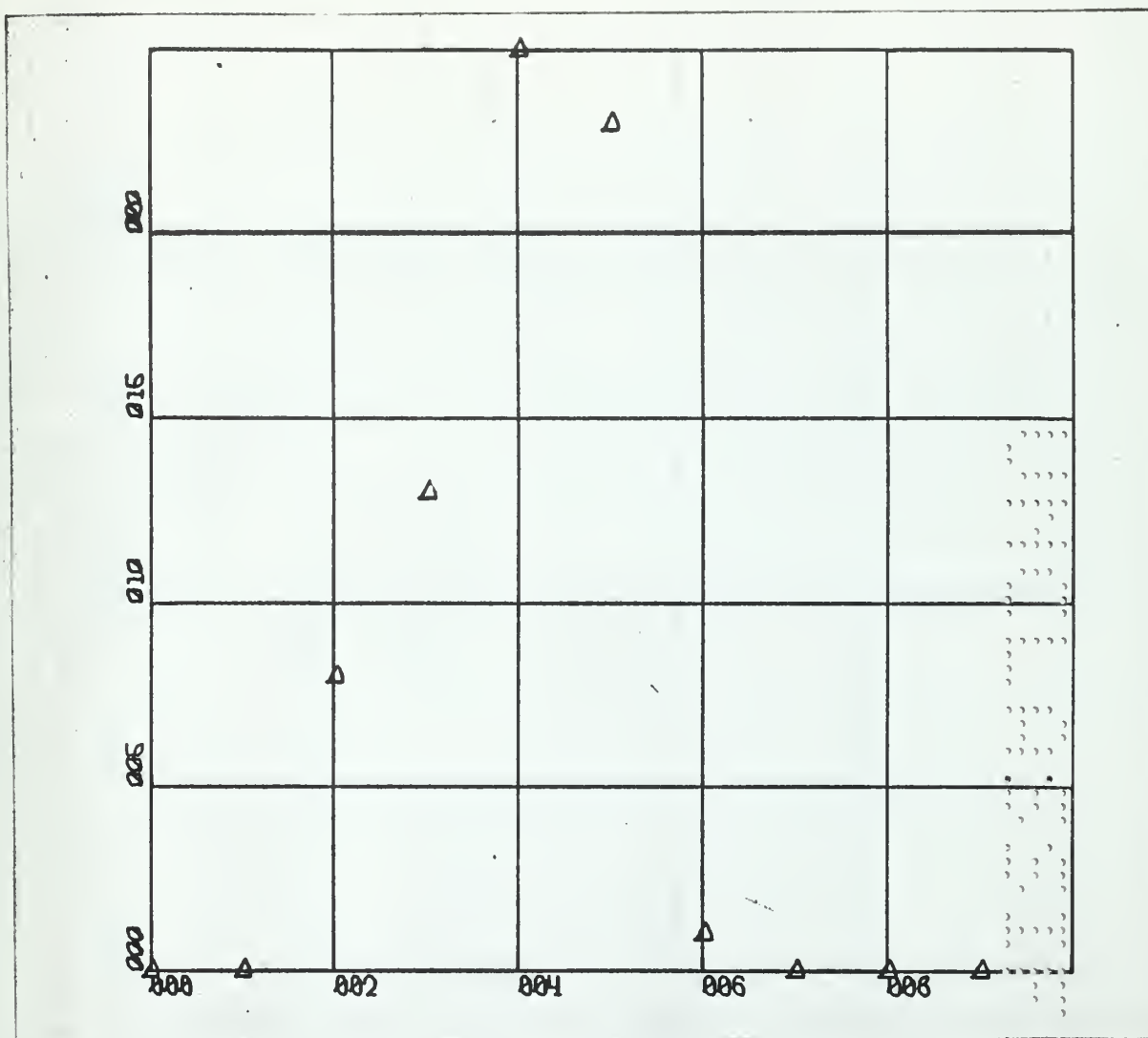
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X-Scale: 1=CAPT
2=CDR
3=LCDR
4=LT
5=LTJG
6=ENS

Y-Scale=Accidents x 10

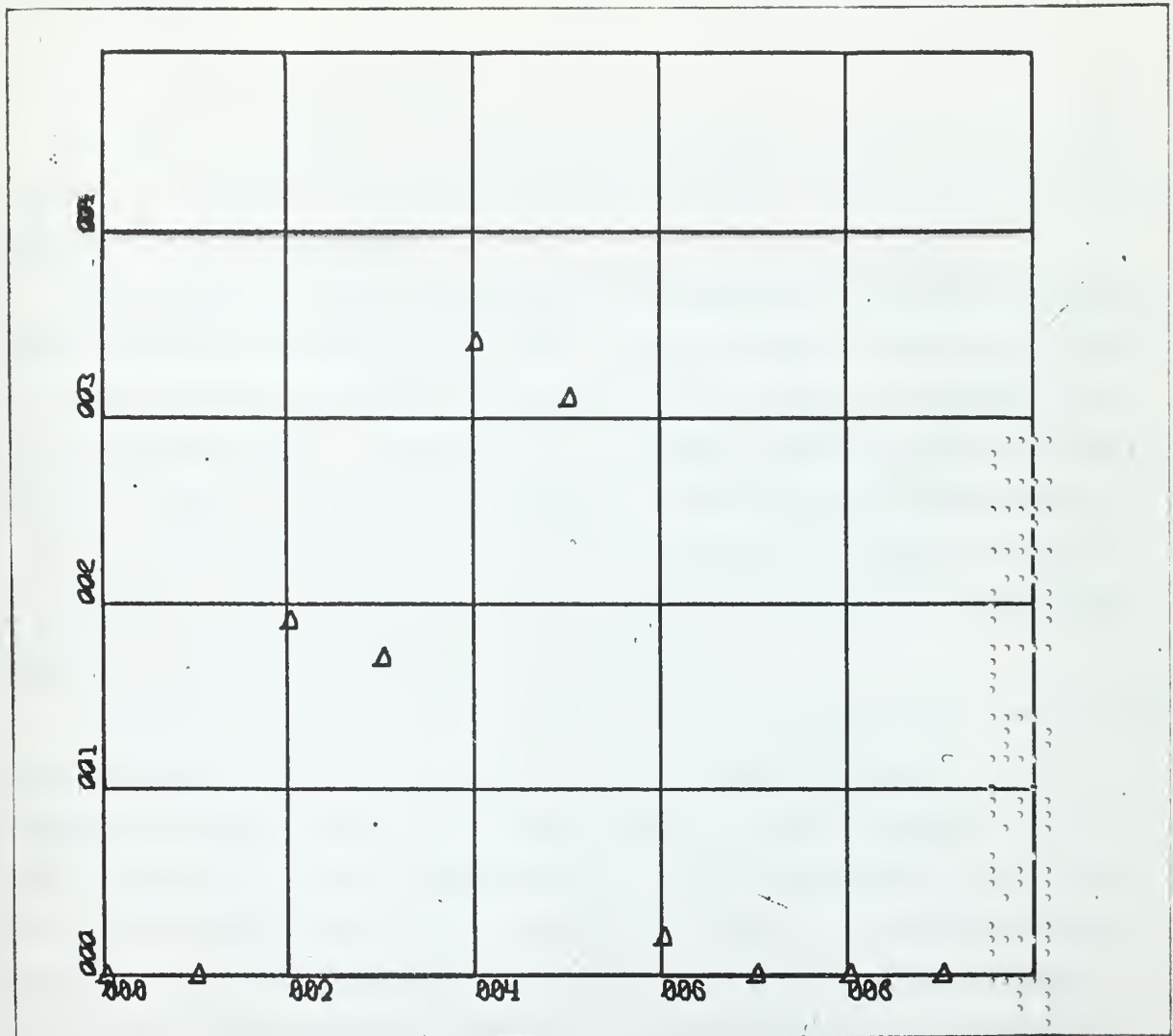
Fig. 11a. Pilot rank, Combined Fleets.



X-Scale: 1=CAPT
 2=CDR
 3=LCDR
 4=LT
 5=LTJG
 6=ENS

Y-Scale=Accidents

Fig. 11b. Pilot rank, 6th FLEET.



X-Scale: 1=CAPT
 2=CDR
 3=LCDR
 4=LT
 5=LTJG
 6=ENS

X-Scale=Accidents x 10

Fig. 11c. Pilot rank, 7th FLEET.



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14. Pilot Time in Type Aircraft.

Number of accidents as a function of pilot hours in the particular type aircraft was studied for each of the fleet breakdowns. Figs. 12a, 12b and 12c represent the various fleets.

In all cases, a sharp rise occurred in the number of accidents involving pilots with less than 200 hours in type. Pilots normally commence a carrier tour with more than 50 hours in type since this is usually a requirement of the training squadrons. Therefore, the accidents shown for pilots with less than this amount of time can be attributed in most cases to incorrect data. In the few cases where pilot hours in type were either omitted in the data or indicated as less than ten hours, the computer programs for drawing the frequency curves interpreted this as zero hours.

A prominent mode existed at about 300 pilot hours in type for each of the fleet categories. Afterwards, the number of accidents decreased with increasing pilot time in type, this drop generally being more gradual than the initial rise and containing some secondary modes and periods of level off. Another mode appeared near 1000 pilot hours in type, and no accidents are shown for pilots with more than 1000 hours. It appears that pilots enter a danger zone as they approach 1000 hours in type and then are immune to accidents after passing this threshold. However, the explanation for this mode lies in the manner in which the data is coded. Two columns of the punch cards are used by NASC to code pilot hours in type, this data being expressed in tens of hours. A pilot having 267 hours in type is coded as 26. By this scheme, 990 hours is the maximum that can be coded. Of the 300 accidents involved in this study, there were ten accidents where the pilot time in type was coded as 99. Since this indicates 990 hours or more, it seems reasonable to expect not a mode, but a continuation of the decreasing curve in this area.

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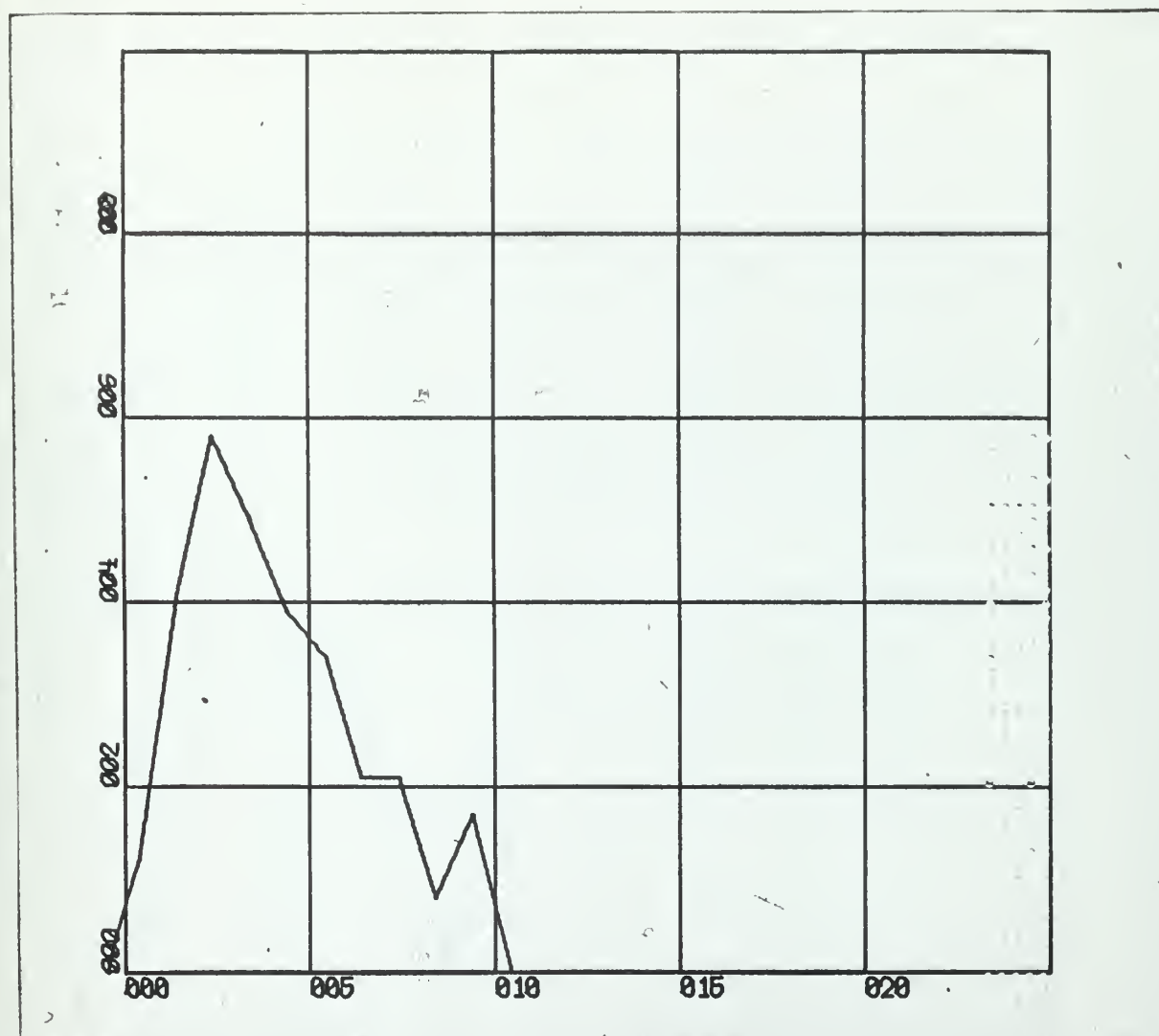
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Figs. 12a, 12b and 12c represent only those pilots that were flying from the carriers. In order to detect areas of time in type aircraft where accident potential is significant, these plots must be compared with the distribution of pilot time in type for all the pilots aboard the CVA's. This data was not available for this study.



X-Scale=Hours x 100

Y-Scale=Accidents x 10

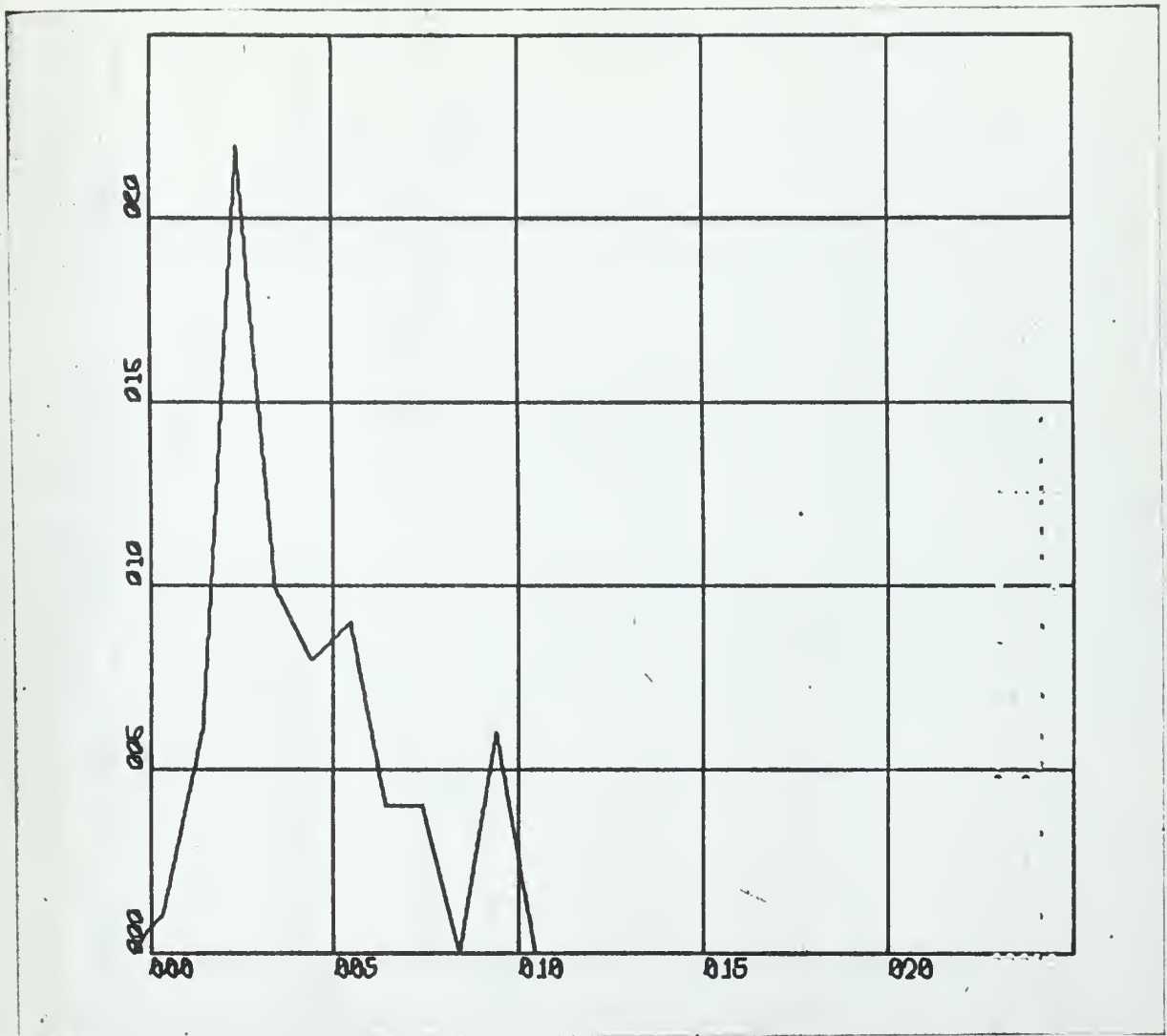
Fig. 12a. Time in type aircraft, Combined Fleets.



1. The temperature of the water in the beaker was 1°C at the start of the experiment.
 2. The temperature of the water in the beaker was 2°C after 1 minute.
 3. The temperature of the water in the beaker was 4°C after 2 minutes.
 4. The temperature of the water in the beaker was 3°C after 3 minutes.
 5. The temperature of the water in the beaker was 4°C after 4 minutes.
 6. The temperature of the water in the beaker was 4°C after 5 minutes.
 7. The temperature of the water in the beaker was 2°C after 1 minute.
 8. The temperature of the water in the beaker was 1°C after 2 minutes.
 9. The temperature of the water in the beaker was 2°C after 3 minutes.
 10. The temperature of the water in the beaker was 1°C after 4 minutes.
 11. The temperature of the water in the beaker was 2°C after 5 minutes.

Figure 1: Temperature of water in beaker over time.
 (a) Temperature of water in beaker over time.

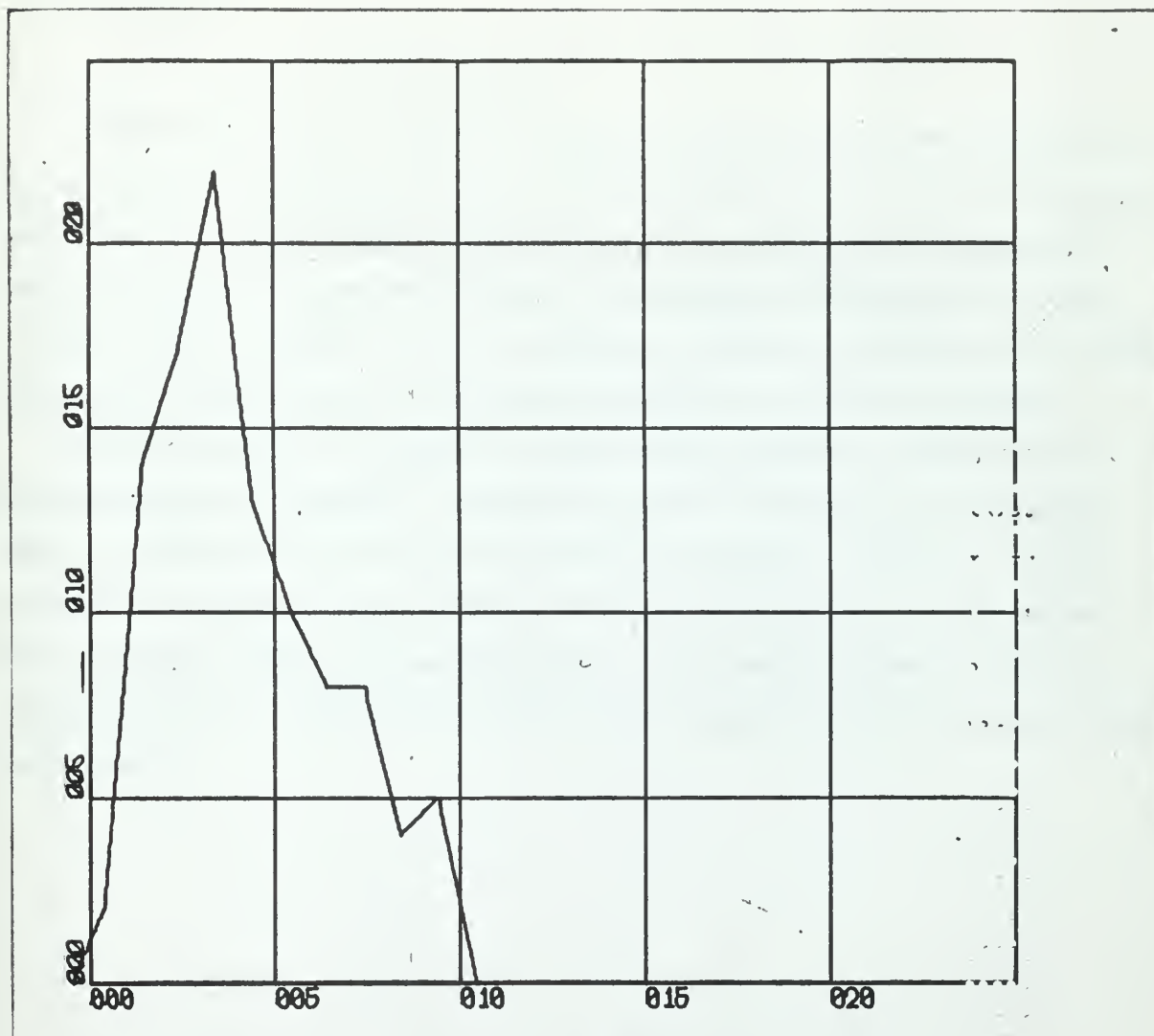
The temperature of the water in the beaker was 1°C at the start of the experiment.



X-Scale=Hours x 100

Y-Scale=Accidents

Fig. 12b. Time in aircraft, 6th FLEET.



X-Scale=Hours x 100

Y-Scale=Accidents

Fig. 12c. Time in type aircraft, 7th FLEET.

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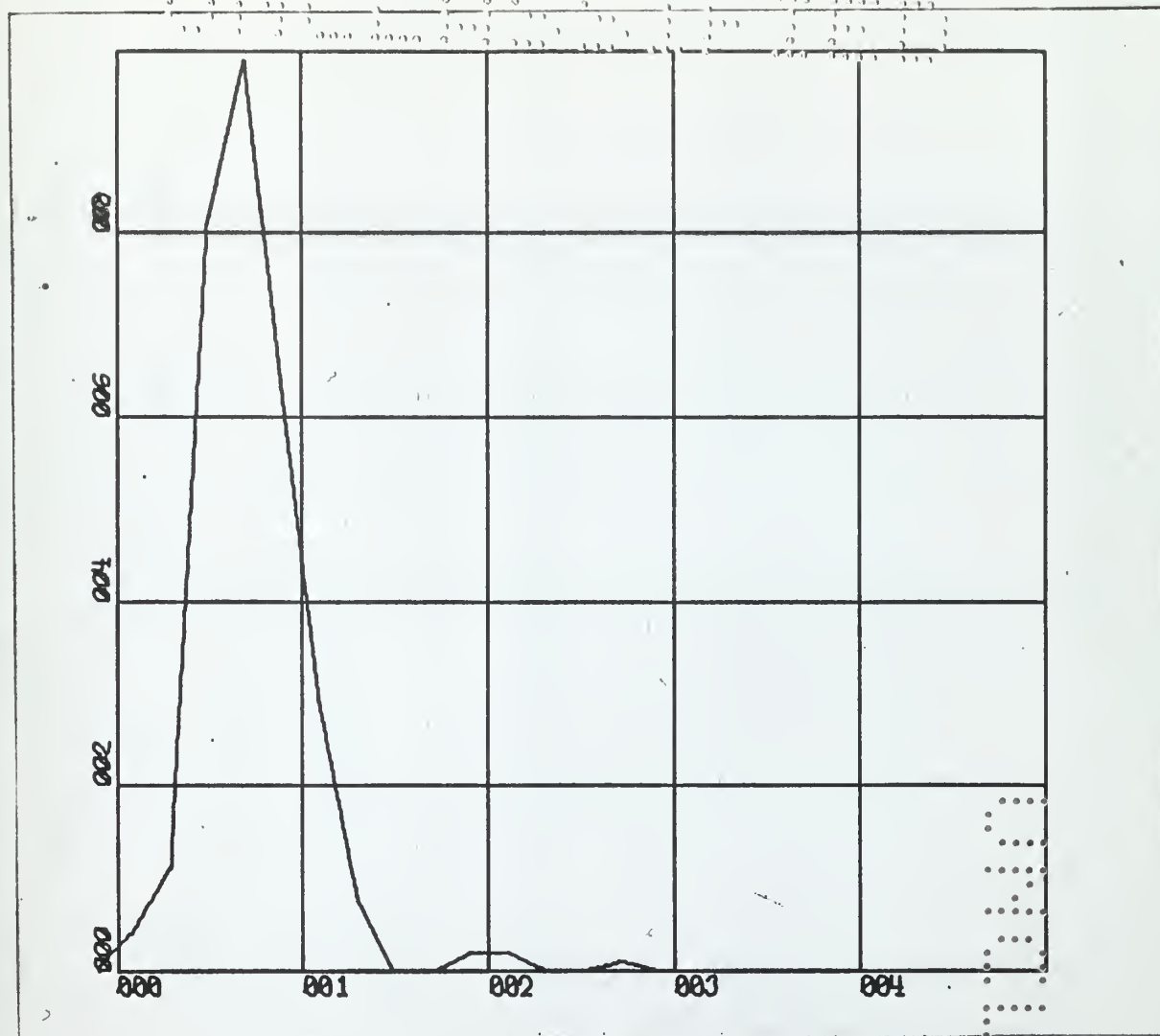
15. Pilot Time, Last Three Months.

Frequencies for the number of pilot hours during the three months prior to an accident are plotted in Figs. 13a, 13b and 13c. The curves are similar, each having a mode at 50-70 hours with a much smaller mode appearing at about 200 hours. Under the K-S test, no significant difference was found to exist at the .1 level. The data indicating more than 150 pilot hours in the three month period prior to an accident should be viewed with caution.

A pilot who flies 20 hours per month on the average, as did most of those involved in accidents, can be expected to remain at an acceptable level of proficiency under normal operating conditions. However, further study of the number of hours flown in the last 30 days and the last seven days may show areas of potential hazard. It is possible that too much or too little flying in a short time span such as a month or even less, can affect performance.

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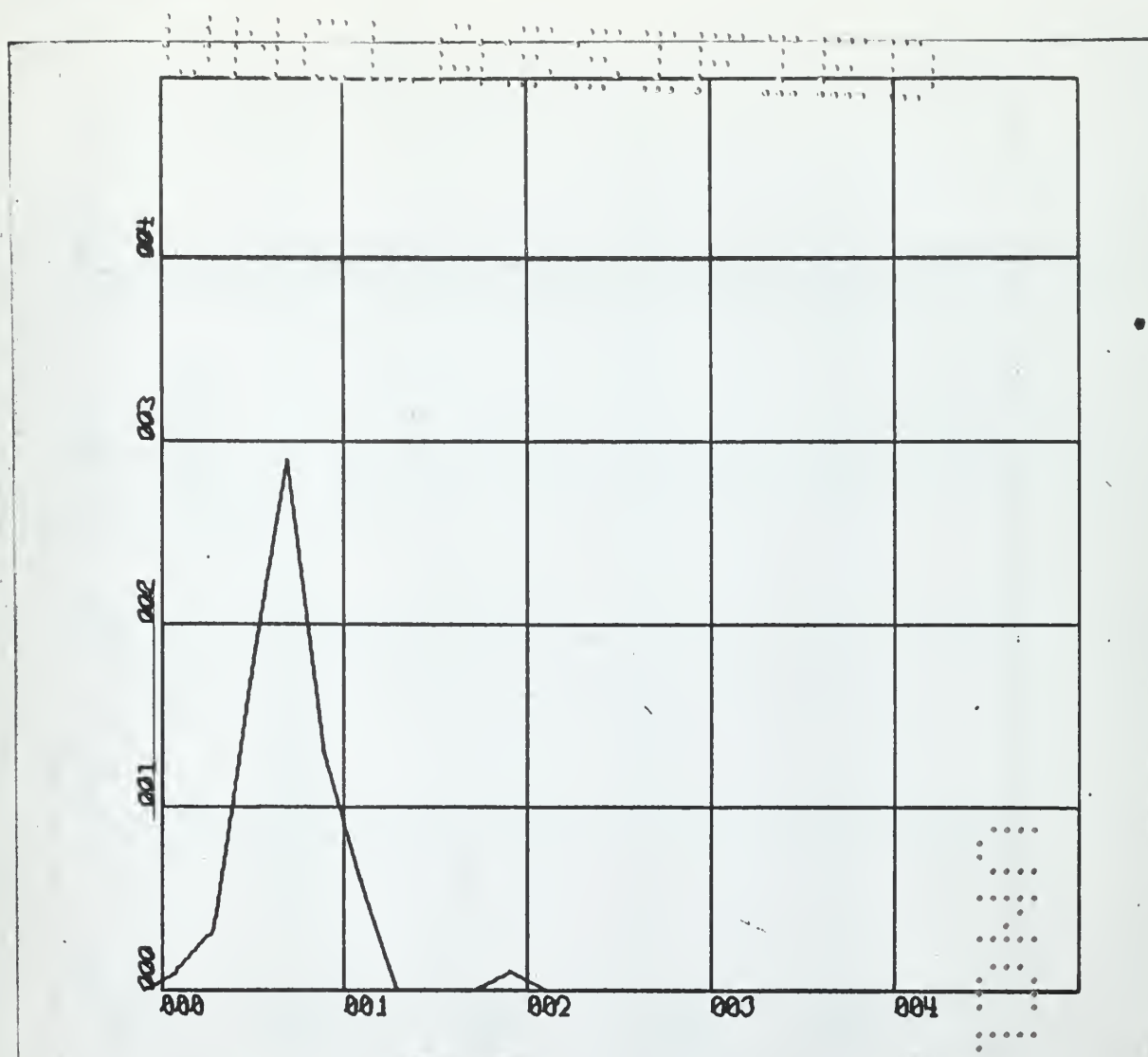
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X-Scale=Hours x 100

Y-Scale=Accidents x 10

Fig. 13a. Pilot time last three months, Combined Fleets.



X-Scale=Hours x 100

Y-Scale=Accidents x 10

Fig. 13b. Pilot time last three months, 6th FLEET.

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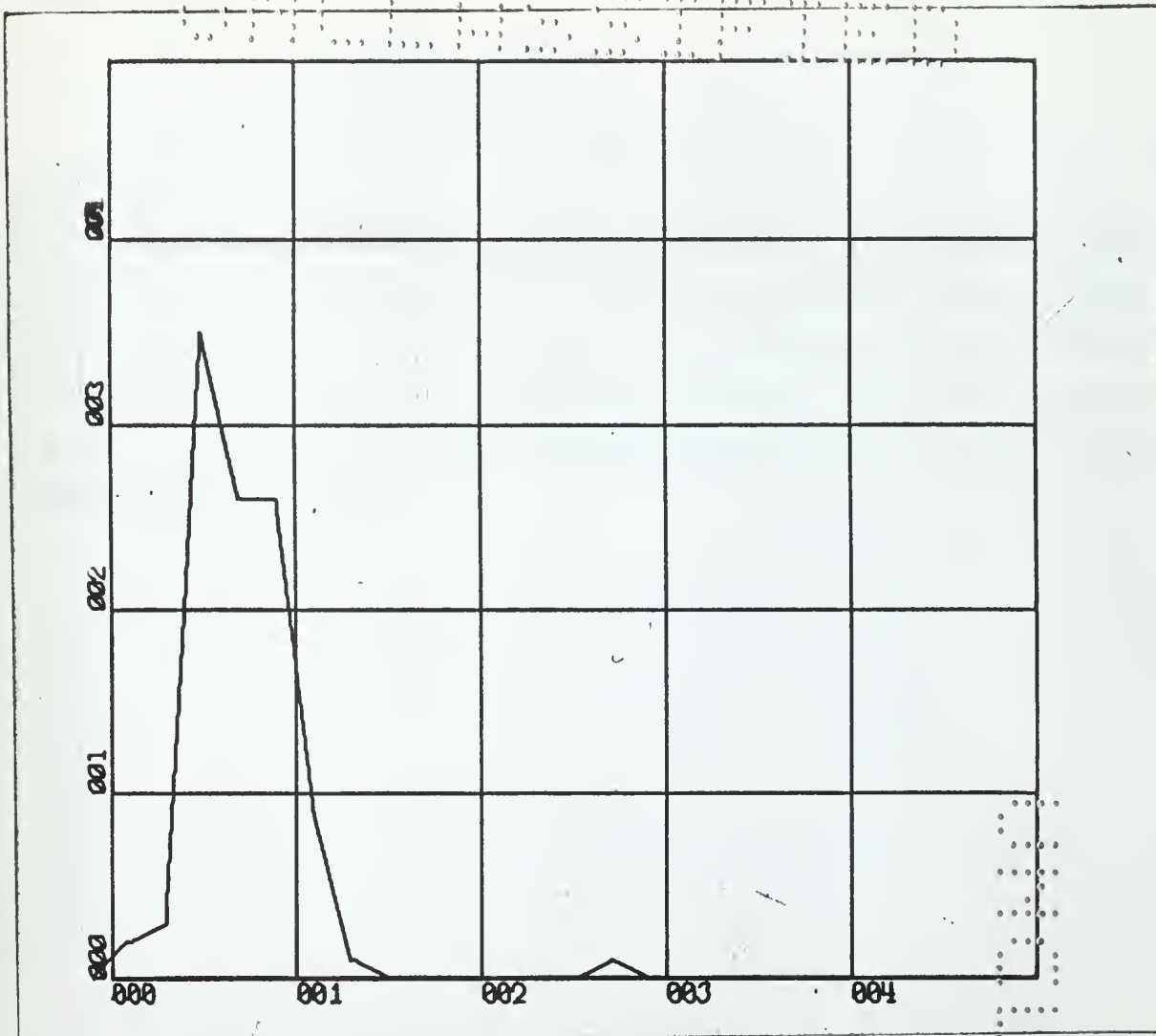
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X-Scale=Hours x 100

Y-Scale=Accidents x 10

Fig. 13c. Pilot time last three months, 7th FLEET.

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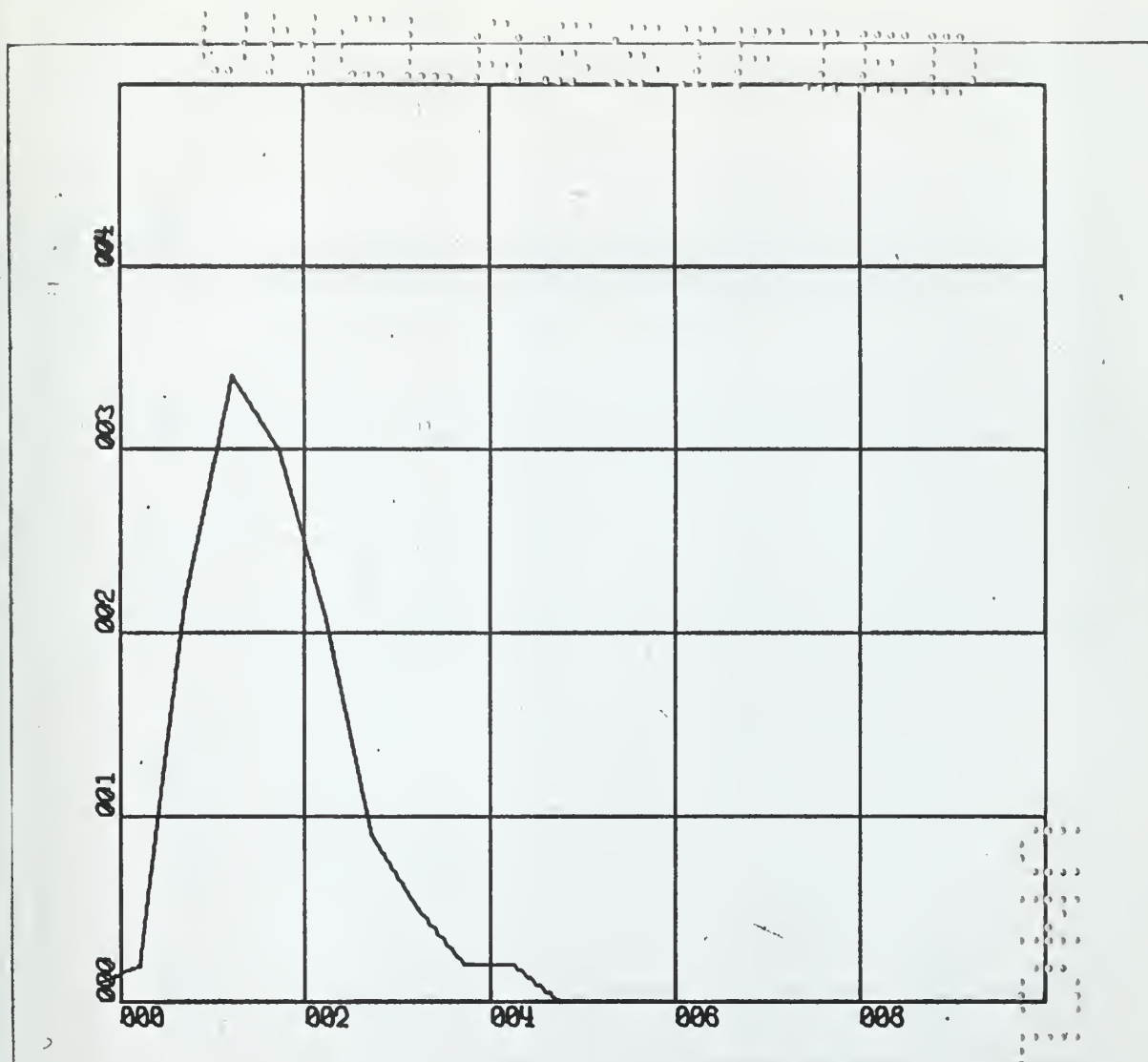
16. Night Time Last Three Months.

Figs. 14a, 14b, and 14c show the night pilot time in the last three months preceding a night accident. The total number of night accidents in the combined fleets for 1962 and 1963 was 128. Of these, 29 occurred in the SIXTH FLEET and 42 in the SEVENTH FLEET. Each of the deployed fleets suffered 41 percent of their accidents at night. Their cumulative percentage distributions did not differ at the .1 level of significance. Each had a mode at 15 hours. According to the plots, the average night time per month was between five and six hours.

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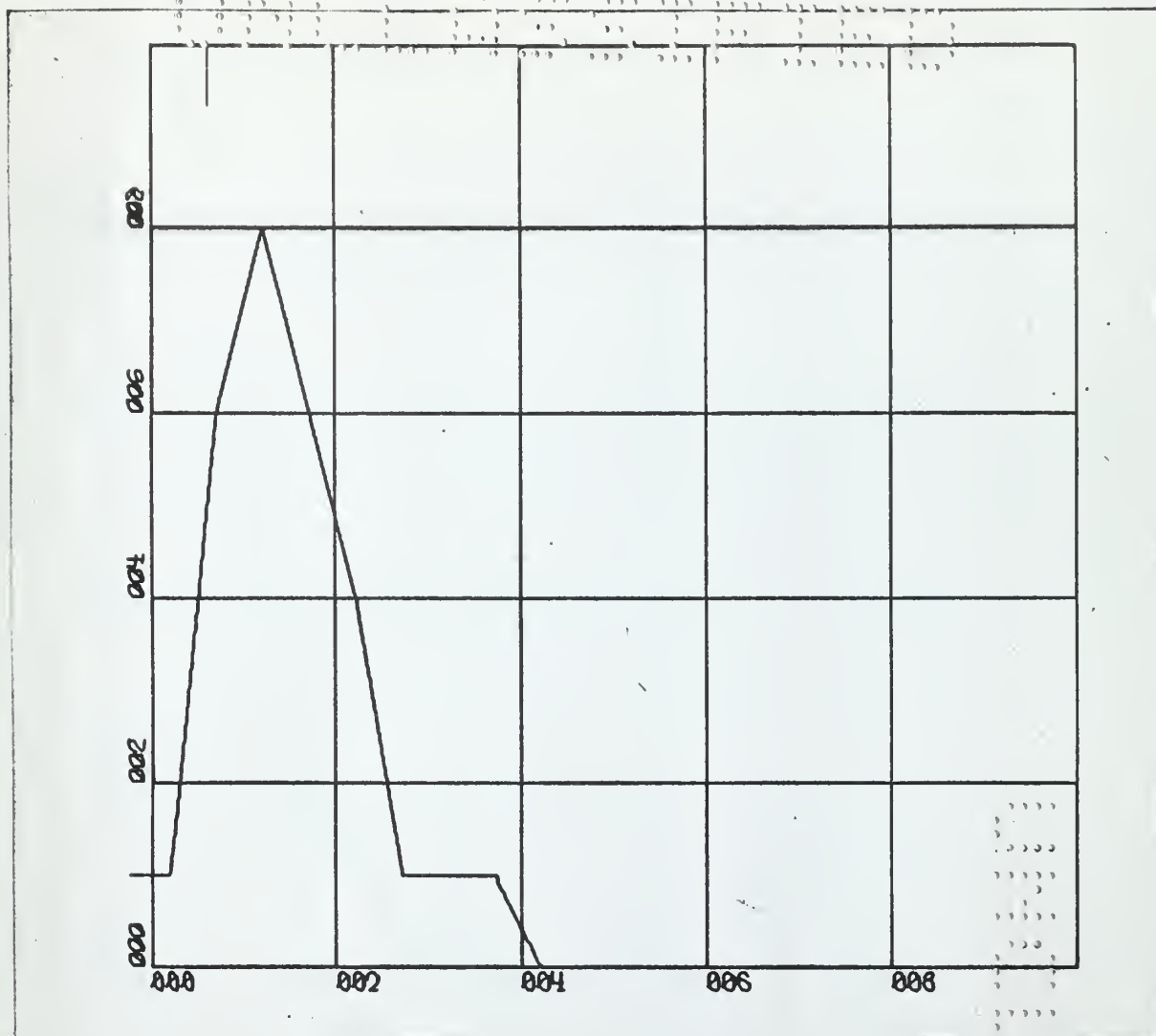


X-Scale=Hours x 10

Y-Scale=Accidents x 10

Fig. 14a. Night time last three months, Combined Fleets.

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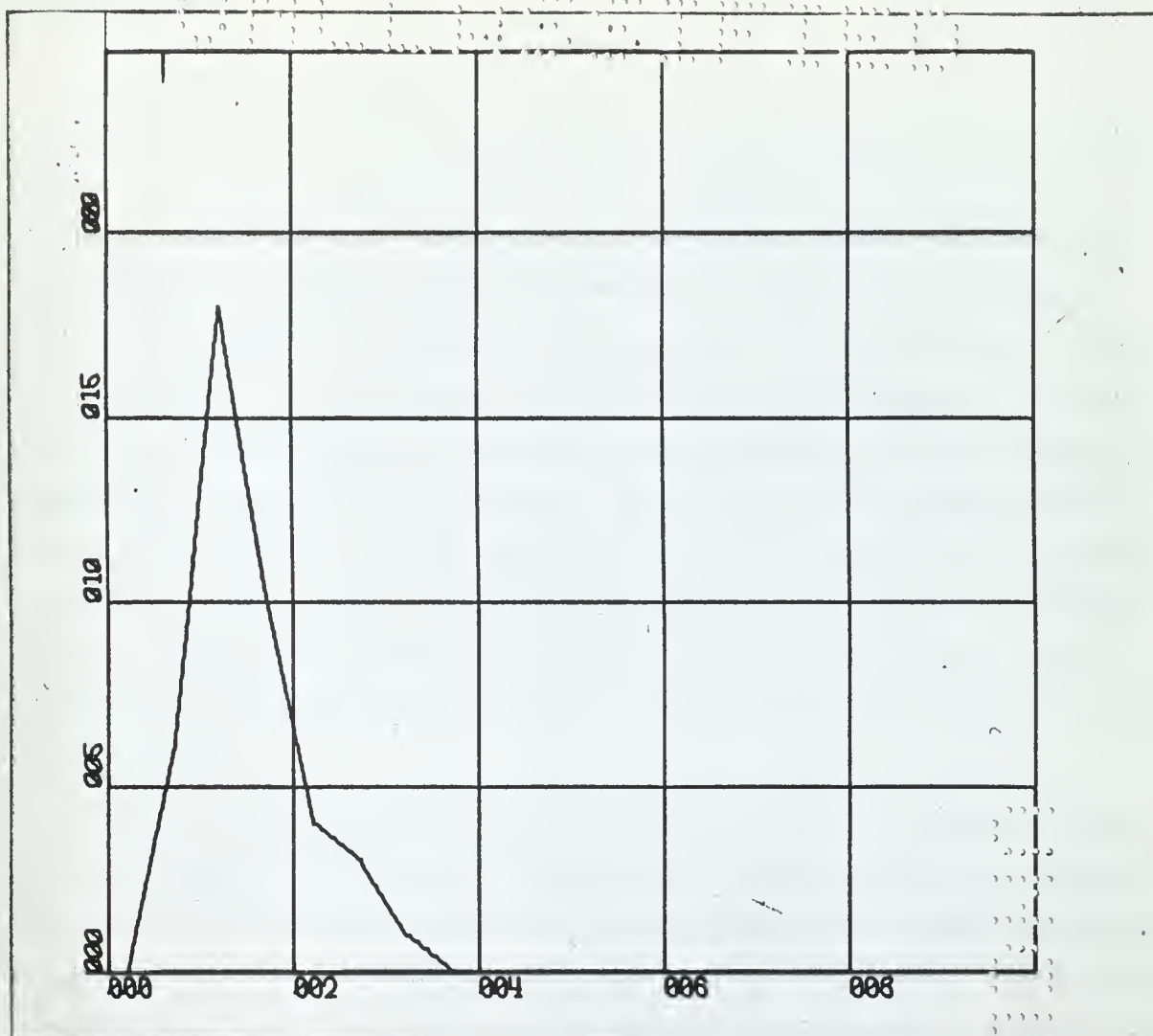
X-Scale=Hours x 10

Y-Scale=Accidents

Fig. 14b. Night time last three months, 6th FLEET.

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X-Scale=Hours x 10

Y-Scale=Accidents

Fig. 14c. Night time last three months, 7th FLEET.

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17. Areas for Further Study.

The assumption was made in Section 2 that whenever a CVA was reported to be at sea, flight operations were being conducted. This is generally true for most operating days. However, days of replenishment, restricted ship maneuvering and periods of crew rest while at sea make this assumption somewhat erroneous. In addition, all flying days are not the same. During fleet operations and exercises, the carriers sometimes operate on a continuous basis for several days, whereas a routine operating day may begin after sunrise and terminate before midnight. Some carriers limit night operations on the first night out of port in order to permit pilots to make one day landing before flying at night. A detailed examination of the type of operations that was being conducted when an accident occurred may provide useful information in understanding the causes and predicting the occurrence of aircraft accidents.

Certain variables such as the number of pilot hours, instrument hours and night hours are collected for the three month period prior to an accident. It is possible that these figures could indicate satisfactory performance over the entire period while the true status was very much different. The situation where a pilot flies 15 night hours at the beginning of this period and does not fly again at night until his accident, two months later, would not be detected with the present data. Similarly the total number of carrier landings, as presently collected, does not provide data concerning a period immediately prior to the accident. This information is usually contained in the body of the accident report, but is not coded on the punch cards. Analysis of operational performance for a short period immediately prior to an accident may reveal trends which could be useful in future accident prevention programs.

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The rise in accidents toward the end of a deployment may be caused by many factors. Such areas as increased operating rate and commitments, over-confidence and fatigue are recommended for study. Another factor which may contribute to accident causation is the port of call. It is well known that some ports offer more recreation for the crew than do others. A study of the accidents which occur after the carrier leaves a particular port may reveal the effects of this factor.

The variables examined in this study pertained only to those pilots involved in accidents. A study of the same variables for pilots who did not have accidents is recommended. In addition, an analysis of variance may produce interesting results in establishing the effects of some of the variables.

The data presently collected which describes aircraft accidents has been valuable in reducing the occurrence of accidents. However, it is not sufficient to thoroughly analyze the underlying causes which do not appear in studies such as this. The use of an experimental design model is recommended to aid in the determination of meaningful variables which will further the progress of accident prediction and prevention.

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APPENDIX I
OPNAV ZULU DATA

Operating data for the units based aboard CVA class carriers was supplied for this study by NAVCOSSACT in the form OPNAV ZULU Reports recorded on high density tapes. This data consists of operational and maintenance information for every aviation unit presently in commission in the Navy, and is compiled in 558 character records, each record covering the performance of the unit for a one-month period. The format of the record lists the BNEP (Basic Naval Establishment Plan) Code, Command Code and Unit Code as identifiers of the units submitting the reports. Since there are many aviation units which have the same BNEP and Command Codes, the Unit Code must be used to select particular squadrons, such as those which served aboard CVA's. Once the Unit Code is known, the location of a squadron can be obtained by a cross check of the Master Locator File for the particular month desired. However, the Unit Code undergoes monthly change, and in order to utilize the information contained in the OPNAV ZULU Reports over an extended period of time, it is necessary to locate each desired Unit Code on the Master Locator File for each month. These Unit Codes must then be matched, by month, against the OPNAV ZULU Reports so that the proper units may be selected. Although the Master Locator Files were available for the 24 months covered by this study, time was not available to complete this process.

Since much of the data contained in the OPNAV ZULU Reports is related to maintenance and readiness of aircraft, only those portions pertaining to actual operating performance were desired for this study. An object program was written by Lois Brunner of the USNPGS Computer Facility which will screen and edit the high density OPNAV ZULU Tapes. Output is low density 88 character records consisting only of operational data for 1962 and 1963 for those squadrons whose BNEP Code indicate CVA operations. The output format and program listing are included at the end of this appendix.

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1. The first part of the paper is devoted to the study of the properties of the function $f(x)$ defined by the equation

$$f(x) = \sum_{n=0}^{\infty} \frac{a_n}{n!} x^n$$

where a_n are the coefficients of the power series. It is shown that the function $f(x)$ is analytic in the whole plane and that it satisfies the differential equation

$$f'(x) = f(x) + x f''(x)$$

which is a special case of the more general equation

$$f'(x) = f(x) + x^k f''(x)$$

where k is an arbitrary real number. The function $f(x)$ is called the *generalized exponential function*.

2. In the second part of the paper, the properties of the function $f(x)$ are studied for different values of the parameter k . It is shown that for $k < -1$ the function $f(x)$ has a unique zero in the interval $(0, \infty)$.

3. In the third part of the paper, the properties of the function $f(x)$ are studied for different values of the parameter k . It is shown that for $k > -1$ the function $f(x)$ has no zeros in the interval $(0, \infty)$.

4. In the fourth part of the paper, the properties of the function $f(x)$ are studied for different values of the parameter k . It is shown that for $k = -1$ the function $f(x)$ has a unique zero in the interval $(0, \infty)$.

5. In the fifth part of the paper, the properties of the function $f(x)$ are studied for different values of the parameter k . It is shown that for $k = 0$ the function $f(x)$ has no zeros in the interval $(0, \infty)$.

6. In the sixth part of the paper, the properties of the function $f(x)$ are studied for different values of the parameter k . It is shown that for $k < -1$ the function $f(x)$ has a unique zero in the interval $(0, \infty)$.

7. In the seventh part of the paper, the properties of the function $f(x)$ are studied for different values of the parameter k . It is shown that for $k > -1$ the function $f(x)$ has no zeros in the interval $(0, \infty)$.

8. In the eighth part of the paper, the properties of the function $f(x)$ are studied for different values of the parameter k . It is shown that for $k = -1$ the function $f(x)$ has a unique zero in the interval $(0, \infty)$.

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UNCLASSIFIED

REVISED OPNAV ZULU FORMAT

Card Columns

1	Type
2-3	BNEP Code
4-5	Command Code
6-10	Model Plan Code
11-15	Unit Code
16-23	Model Description
24-25	Month
26	Year
27-31	Total Flying Hours
32-36	Total Flights
37-41	Carrier Arrested Landings (Day)
42-46	Carrier Arrested Landings (Night)
47-51	Bolter (Day)
52-56	Bolter (Night)
57	Flight Purpose Code
58-61	Flights
62-66	Hours
67	Flight Purpose Code
68-71	Flights
72-76	Hours

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APPENDIX I

02190004	TESTIA	0188	L070+9510568+65	PNTS1
02200007	MCWBANK	0176	L073/021056MV16188	PNTS1
02210007	MCWAREA4	0156	L073/091056M628176	PNTS1
02220007	MCWAREA3	0146	L073/161056M598156	PNTS1
02230007	MCWAREA2	0136	L073/231056M578146	PNTS1
02240007	MCWAREA1	0101	L073/301056M436136	PNTS1
02250008	MCWAREA1		L074/381056M(U4)101W	PNTS1
02260005	MCWAREA1		L071/431056BS91L	PNTS1
02270005	MCWAREA1		L071/481056BU30K	PNTS1
02280004	MCWAREA1		L070/521056B+00	PNTS1
02290004	MCWAREA1		L070/561056HS09	PNTS1
02300004	MCWAREA1		L073/631056DU67V18	PNTS1
02310004	MCWAREA1		L071/681056U(U2B	PNTS1
02320004	MCWAREA1		L074/761056M(U2401R	PNTS1
02330004	MCWAREA1		L070/801056HV01	PNTS1
02340004	MCWAREA1		L071/851056BS10K	PNTS1
02350004	MCWAREA1		L073/921056AV19V18	PNTS1
02360004	MCWAREA1		L074S001056BS06V189	PNTS1
02370004	MCWAREA1		L071S0510568/64L	PNTS1
02380004	MCWAREA1		L070S091056B000	PNTS1
02390004	MCWAREA1		L071S141056U(U2U	PNTS1
02400004	MCWAREA1		L073S2210562	PNTS1
02410004	MCWAREA1		L073S291056MY50240	PNTS1
02420004	MCWAREA1		L073S3010562	PNTS1
02430004	MCWAREA1		L073S371056MY82240	PNTS1
02440004	MCWAREA1		L073S3810562	PNTS1
02450004	MCWAREA1		L073S451056MZ14240	PNTS1
02460004	MCWAREA1		L073S4610562	PNTS1
02470004	MCWAREA1		L073S531056MZ46240	PNTS1
02480004	MCWAREA1		L073S5410562	PNTS1
02490004	MCWAREA1		L073S611056MZ78240	PNTS1
02500004	MCWAREA1		L068S631056FA	PNTS1
02510004	MCWAREA1		L067S6410562	PNTS1
02520004	MCWAREA1		L067S651056/	PNTS1
02530004	MCWAREA1		L067S661056/	PNTS1
02540004	MCWAREA1		L067S671056	PNTS1
02550004	MCWAREA1		L071S721056BS77D	PNTS1
02560004	MCWAREA1		L070S761056B+00	PNTS1
02570004	MCWAREA1		L071S811056U(U4M	PNTS1
02580004	MCWAREA1		L071S861056U(U4U	PNTS1
02590004	MCWAREA1		L070S901056.S87	PNTS1
02600004	MCWAREA1		L070S941056HT35	PNTS1
02610004	MCWAREA1		L0731011056DU67V17	PNTS1
02620004	MCWAREA1		L0731081056DU67V18	PNTS1
02630004	MCWAREA1		L0711131056U(U4B	PNTS1
02640004	MCWAREA1		L0741211056M(U4101W	PNTS1
02650004	MCWAREA1		L0711261056BT36L	PNTS1
02660004	MCWAREA1		L0711311056BU30K	PNTS1

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APPENDIX I

12070004TWERRTB	0000	ERCNIR	9TRY 10 TIMES	L070135110568000	PNTS1
12080007TWERR1A	NB1	ERCNTR		L0731421056AV19V18	PNTS1
12090008	TWERR2			L07415010568T55V189	PNTS1
12100004	CWERR			L07015410568T09	PNTS1
12110007TWERR2A	NB1	SKPCNT		L0731611056AV19V17	PNTS1
12111507	ZERO3	ERCNTR		L0731681056DU67V18	PNTS1
12120005	CU (U4)	SKPCNT	ESKIP TAPE	L0711731056U(U4E	PNTS1
12130008	CU BADTAP		4TRY 3X10 TIMES	L07418110568T86V174	PNTS1
12140004	B MWERR	0299		L07018510568T14	PNTS1
12150007BADTAPMCWB	MCWB			L0731921056MW86299	PNTS1
12160001	W	0320		L06719310562	PNTS1
12170007	MCWB			L073U001056MX86320	PNTS1
12180002	CC		A	L068U021056FA	PNTS1
12190001	W			L067U0310562	PNTS1
12200001	CS			L067U0410566/	PNTS1
12210001	CS			L067U0510566/	PNTS1
13010001	H			L067U0610566	PNTS1
13020005	B		D	L071U1110568T16D	PNTS1
13030004	RENT			L070U1510568T14	PNTS1
13040005	CU (U4)		MWRITE TAPE MARK	L071U201056U(U4M	PNTS1
13050005	CU (U4)		UUNLOAD TAPE 4	L071U251056U(U4U	PNTS1
13060004	B MWERR			L070U2910568T14	PNTS1
13110005TWEOR	CU (U4)		BACKSPACE 4	L071U341056U(U4B	PNTS1
13120005	CU (U4)		MTAPE MARK 4	L071U391056U(U4M	PNTS1
13130005	CU (U4)		UUNLOAD 4	L071U441056U(U4U	PNTS1
13140007	MCWENTAP	0280		L073U511056MV90280	PNTS1
13150002	CC		A	L068U531056FA	PNTS1
13160001	W			L067U5410562	PNTS1
13170001	CS			L067U5510566/	PNTS1
13180001	CS			L067U5610566/	PNTS1
13190001	H			L067U57105668/31	PNTS1
13200004	B			L02608910566	FPNTS1
8001003X1	TWRITE			L026U6410566	FPNTS1
80020003NB2	DCW**	002		L026U6710566	FPNTS1
80030003ZER03	DCW**	000		L024U6810566	FPNTS1
80040001CODES	DCW**			L025U7010566	FPNTS1
80050002	DCW**	023		L025U7210566	FPNTS1
80060002	DCW**	04		L025U7410566	FPNTS1
80070002	DCW**	05		L025U7610566	FPNTS1
80080002	DCW**	06		L025U7810566	FPNTS1
80090002	DCW**	08		L025U8010566	FPNTS1
80100002	DCW**	09		L025U8210566	FPNTS1
80110002	DCW**	13		L025U8410566	FPNTS1
80120002	DCW**	14		L025U8610566	FPNTS1
80130002	DCW**	22		L025U8810566	FPNTS1
80140002	DCW**	29		L025U9010566	FPNTS1
80150002	DCW**	34		L025U9210566	FPNTS1
80160002	DCW**	38		L025U9410566	FPNTS1
80170002	DCW**				FPNTS1

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8018002	DCW*
8019002	DCW*
8101001	1GPMWDMDCW0959
8102001	1GRPMKWDWCW0189
8103003	TEMP
8104003	3NB482
8105012	BLANK
8106001	1SKPCNTDCW*
8107001	1ERCNTRDCW*
8108001	1NB1
8110032	DCW*
8111032	DC
8112007	ENTAP
8114032	DC
8115032	DC
8116032	BTMSG1DC
8117032	DCW*
8118032	DC
8119032	DC
8120004	BTMSG2DC
8121032	2EOR2M1DCW*
8122032	2EOR2M2DCW*
8123032	2EOR2M3DCW*
8124032	2EOR2M4DCW*
8125032	2EOR2M5DCW*
8126032	2EOR2M6DCW*
99999	END1000

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69
482
1
END-OF-REEL ON OUTPUT TAPE 4
MOUNT NEW TAPE PRESS START TO COM
NTINUE.
BAD TAPE ON 4 SET SWITCH D UP AL
ND PRESS START TO WRITE TAPE MARM
K ON 4. UNPOAD TAPE 4 AND MOUNT M
NEW TAPE TO CONTINUE CR REPEAT FL
ROM BEGINNING WITH NEW TAPE ON A
OR SIMPLY PRESS START TO TRY AG
AIN.
END. OF REEL ON INPUT TAPE 2.
MOUNT NEXT INPUT TAPE ON UNIT 2.
PRESS START TO CONTINUE -OR-
IF FINISHED LAST REEL -
SET SWITCH D UP AND PRESS START
TO WRITE TAPE MARK ON OUTPUT 4.

```

[illegible]

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11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

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APPENDIX II
COMPUTER PROGRAMS FOR DATA ANALYSIS

The USNPGS Computer Facility was used to process the data for this study. Programs were written to compute the variables related to ship operations, and the graph subroutine on the computer library tape was used to draw the graphs. Ship movements were transferred from micro-film to data cards by using the numeric code:

O=Ship not deployed
1=Ship deployed, in port
2=Ship deployed, at sea

A 730 day record was made for each CVA so that the proper variables could be computed. The data cards from NASC were used directly as input for the computer. However, because of unidentified multiple punches in the last six columns of each card, these columns were erased and re-numbered.

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100

CHINESE

The Chinese language is one of the most ancient and most widely spoken in the world. It is a member of the Sino-Tibetan family and is spoken by over a billion people in China and other parts of the world. The Chinese language has a long history and a rich cultural heritage. It is a language of great beauty and power, and it is a language that has shaped the world in many ways.

The Chinese language is a complex and beautiful language. It has a long history and a rich cultural heritage. It is a language of great beauty and power, and it is a language that has shaped the world in many ways. The Chinese language is a member of the Sino-Tibetan family and is spoken by over a billion people in China and other parts of the world. It is a language of great beauty and power, and it is a language that has shaped the world in many ways.

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A. PROGRAM THESIS

This program computes the following variables related to ship operations for each accident:

1. Number of days at sea immediately prior to accident
2. Number of days in port immediately prior to accident
3. Number of days since beginning of deployment until accident
4. Number of days at sea since beginning of deployment until accident
5. Number of days in port since beginning of deployment until accident
6. Number of days after accident until deployment is over
7. Number of days since 1 January 1962 until accident
8. Number of days (regardless of deployed status) between accidents

If an accident occurred on deployment, all of the variables are computed. Otherwise, only certain applicable ones are computed and a note is written to this effect.

Input data consists of the coded ship movements using 80 columns of the card, each column representing the status for one day. Since this program was written for 730 days, this number appears in the program. These ship operating schedules are read into the computer in order of increasing ship hull numbers. The data for each accident is read from the NASC data cards. Routines for the various calculations are explained in comments in the program listing.

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APPENDIX II A

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-COOP,,POWELL,S/1S/2S,25,50000,4.
-FTN,L,E.
PROGRAM THESIS
TYPE INTEGER DATE, SHIP, A, B, C, D, E, F, G
TYPE INTEGER H,FLT
DIMENSION IDATE(300), DATE(730), ICVA(300), SHIP(730), I59(730),
1I60(730), I61(730), I62(730), I63(730), I64(730), I65(730),
1I41(730), I42(730), I43(730), I11(730), I14(730), I16(730),
1I19(730), I31(730), I34(730), I38(730), A(300), B(300), C(300),
1D(300), E(300), F(300), G(300), KK(300), LL(300), IND(300)
DIMENSION IG(300), H(300), FLT(300)
READ 2000, (I11(J), J=1,730)
READ 2000, (I14(J), J=1,730)
READ 2000, (I16(J), J=1,730)
READ 2000, (I19(J), J=1,730)
READ 2000, (I31(J), J=1,730)
READ 2000, (I34(J), J=1,730)
READ 2000, (I38(J), J=1,730)
READ 2000, (I41(J), J=1,730)
READ 2000, (I42(J), J=1,730)
READ 2000, (I43(J), J=1,730)
READ 2000, (I59(J), J=1,730)
READ 2000, (I60(J), J=1,730)
READ 2000, (I61(J), J=1,730)
READ 2000, (I62(J), J=1,730)
READ 2000, (I63(J), J=1,730)
READ 2000, (I64(J), J=1,730)
READ 2000, (I65(J), J=1,730)
2000 FORMAT(80I1)
DO 3000, I=1,300
READ 3001, IDATE(I),KK(I),LL(I)
3001 FORMAT (I5, A8, A8)
READ 3002, ICVA(I)
3002 FORMAT (66X, I2, /)
3000 CONTINUE
C DATES ARE SET SUCH THAT DATE(I) = 20101, DATE(365) = 21231,

```


C DATE(366) = 30101, DATE(730) = 31231.

C JANUARY 1962

C DATE(1) = 20101

DO 1, I=1,30

DATE(I+1)=DATE(I)+1

1 CONTINUE

C FEBRUARY 1962

DATE(32)=20201

DO 2 I=32,58

DATE(I+1)=DATE(I)+1

2 CONTINUE

C MARCH 1962

DATE(60)=20301

DO 3 I=60,89

DATE(I+1)=DATE(I)+1

3 CONTINUE

C APRIL 1962

DATE(91)=20401

DO 4 I=91,119

DATE(I+1)=DATE(I)+1

4 CONTINUE

C MAY 1962

DATE(121)=20501

DO 5 I=121,150

DATE(I+1)=DATE(I)+1

5 CONTINUE

C JUNE 1962

DATE(152)=20601

DO 6 I=152,180

DATE(I+1)=DATE(I)+1

6 CONTINUE

C JULY 1962

DATE(182)=20701

DO 7 I=182,211

DATE(I+1)=DATE(I)+1

7 CONTINUE



C AUGUST 1962
DATE(213)=20801
DO 8 I=213,242
DATE(I+1)=DATE(I)+1
8 CONTINUE

C SEPTEMBER 1962
DATE(244)=20901
DO 9 I=244,272
DATE(I+1)=DATE(I)+1
9 CONTINUE

C OCTOBER 1962
DATE(274)=21001
DO 10 I=274,303
DATE(I+1)=DATE(I)+1
10 CONTINUE

C NOVEMBER 1962
DATE(305)=21101
DO 11 I=305,333
DATE(I+1)=DATE(I)+1
11 CONTINUE

C DECEMBER 1962
DATE(335)=21201
DO 12 I=335,364
DATE(I+1)=DATE(I)+1
12 CONTINUE

C JANUARY 1963
DATE(366)=30101
DO 13 I=366,395
DATE(I+1)=DATE(I)+1
13 CONTINUE

C FEBRUARY 1963
DATE(397)=30201
DO 14 I=397,423
DATE(I+1)=DATE(I)+1
14 CONTINUE

15 MARCH 1963
DATE(425)=30301

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APPENDIX II A

DO 15 I=425,454
DATE(I+1)=DATE(I)+1

15 CONTINUE

APRIL 1963

DATE(456)=30401

DO 16 I=456,484

DATE(I+1)=DATE(I)+1

16 CONTINUE

MAY 1963

DATE(486)=30501

DO 17 I=486,515

DATE(I+1)=DATE(I)+1

17 CONTINUE

JUNE 1963

DATE(517)=30601

DO 18 I=517,545

DATE(I+1)=DATE(I)+1

18 CONTINUE

JULY 1963

DATE(547)=30701

DO 19 I=547,576

DATE(I+1)=DATE(I)+1

19 CONTINUE

AUGUST 1963

DATE(578)=30801

DO 20 I=578,607

DATE(I+1)=DATE(I)+1

20 CONTINUE

SEPTEMBER 1963

DATE(609)=30901

DO 21 I=609,637

DATE(I+1)=DATE(I)+1

21 CONTINUE

OCTOBER 1963

DATE(639)=31001

DO 22 I=639,668

DATE(I+1)=DATE(I)+1

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APPENDIX II A

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22 CONTINUE
C   NOVEMBER 1963
   DATE(670)=31101
   DO 23 I=670,698
   DATE(I+1)=DATE(I)+1
23 CONTINUE
C   DECEMBER 1963
   DATE(700)=31201
   DO 24 I=700,729
   DATE(I+1)=DATE(I)+1
24 CONTINUE
   N=300
   DO 100 J=1,N
   THE FOLLOWING ROUTINE DETERMINES THE CVA INVOLVED IN THE
C   ACCIDENT AND TRANSFERS THE OPERATING SCHEDULE TO THE RUNNING
C   VARIABLE, SHIP(I).
   IF(ICVA(J).EQ.59) 110,115
110 DO 111 I=1,730
111 SHIP(I)=I59(I)
   FLT(J)=6
   GO TO 200
115 IF (ICVA(J).EQ.60) 116,120
116 DO 117 I=1,730
117 SHIP(I)=I60(I)
   FLT(J)=6
   GO TO 200
120 IF(ICVA(J).EQ.61) 121,125
121 DO 122 I=1,730
122 SHIP(I)=I61(I)
   FLT(J)=7
   GO TO 200
125 IF(ICVA(J).EQ.62) 126,130
126 DO 127 I=1,730
127 SHIP(I)=I62(I)
   FLT(J)=6
   GO TO 200
130 IF(ICVA(J).EQ.63) 131,135

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131 DO 132 I=1,730
132 SHIP(I)=I63(I)
FLT(J)=7
GO TO 200
135 IF(ICVA(J).EQ.64) 136,140
136 DO 137 I=1,730
137 SHIP(I)=I64(I)
FLT(J)=7
GO TO 200
140 IF(ICVA(J).EQ.65) 141,145
141 DO 142 I=1,730
142 SHIP(I)=I65(I)
FLT(J)=6
GO TO 200
145 IF(ICVA(J).EQ.41) 146,150
146 DO 147 I=1,730
147 SHIP(I)=I41(I)
FLT(J)=7
GO TO 200
150 IF(ICVA(J).EQ.42) 151,155
151 DO 152 I=1,730
152 SHIP(I)=I42(I)
FLT(J)=6
GO TO 200
155 IF(ICVA(J).EQ.43) 156,160
156 DO 157 I=1,730
157 SHIP(I)=I43(I)
FLT(J)=7
GO TO 200
160 IF(ICVA(J).EQ.11) 161,165
161 DO 162 I=1,730
162 SHIP(I)=I11(I)
FLT(J)=6
GO TO 200
165 IF(ICVA(J).EQ.14) 166,170
166 DO 167 I=1,730
167 SHIP(I)=I14(I)

APPENDIX II A

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FLT(J)=7
GO TO 200
170 IF(ICVA(J).EQ.16) 171,175
171 DO 172 I=1,730
172 SHIP(I)=I16(I)
FLT(J)=7
GO TO 200
175 IF(ICVA(J).EQ.19) 176,180
176 DO 177 I=1,730
177 SHIP(I)=I19(I)
FLT(J)=7
GO TO 200
180 IF(ICVA(J).EQ.31) 181,185
181 DO 182 I=1,730
182 SHIP(I)=I31(I)
FLT(J)=7
GO TO 200
185 IF(ICVA(J).EQ.34) 186,190
186 DO 187 I=1,730
187 SHIP(I)=I34(I)
FLT(J)=7
GO TO 200
190 IF(ICVA(J).EQ.38) 191,100
191 DO 192 I=1,730
192 SHIP(I)=I38(I)
FLT(J)=6
GO TO 200

```

```

C THE FOLLOWING ARE COMPUTED USING A CODED OPERATING SCHEDULE,
C 0=SHIP NOT DEPLOYED, 1=SHIP DEPLOYED IN PORT, 2=SHIP DEPLOYED
C AT SEA.
C A(J)=NUMBER OF DAYS AT SEA IMMEDIATELY PRIOR TO ACCIDENT
C B(J)=NUMBER OF DAYS IN PORT IMMEDIATELY PRIOR TO ACCIDENT
C C(J)=NUMBER OF DAYS SINCE BEGINNING OF DEPLOYMENT UNTIL ACCIDENT
C D(J)=NUMBER OF DAYS AT SEA SINCE BEGINNING OF DEPLOYMENT UNTIL
C ACCIDENT
C E(J)=NUMBER OF DAYS IN PORT SINCE BEGINNING OF DEPLOYMENT UNTIL
C ACCIDENT

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APPENDIX II A

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C      F(J)=NUMBER OF DAYS AFTER ACCIDENT UNTIL DEPLOYMENT IS OVER
C      G(J)=NUMBER OF DAYS SINCE 1 JANUARY 1962 UNTIL ACCIDENT
C      H(J)=NUMBER OF DAYS (REGARDLESS OF DEPLOYMENT) BETWEEN ACCIDENTS
C
200  A(J)=0
      B(J)=0
      C(J)=0
      D(J)=0
      E(J)=0
      F(J)=0
      G(J)=0
      DO 205 I=1,730
      IF(IDATE(J).EQ.DATE(I)) 210,205
210  G(J)=I
      IF(SHIP(I).EQ.0) 1111,211
1111 IND(J)=56
      GO TO 100
211  IND(J)=0
C      A(J) IS COMPUTED AS FOLLOWS
      DO 215 K=1,100
      K1=K-1
      IF((I-K1).EQ.0)220,216
216  IF(SHIP(I-K1).EQ.2) 217,220
217  A(J)=A(J)+1
215  CONTINUE
C      B(J) IS COMPUTED AS FOLLOWS
220  DO 225 K=1,100
      K1=K-1+A(J)
      IF((I-K1).EQ.0) 230,226
226  IF(SHIP(I-K1).EQ.1) 227,230
227  B(J)= B(J)+1
225  CONTINUE
C      D(J) IS COMPUTED AS FOLLOWS
230  DO 231 K=1,730
      K1=K-1
      IF((I-K1).EQ.0) 240,232
232  IF(SHIP(I-K1).EQ.0) 240,233

```


APPENDIX II A

```

233 IF(SHIP(I-K1).EQ.2) 234,231
234 D(J)=D(J)+1
231 CONTINUE

```

```

C   E(J) IS COMPUTED AS FOLLOWS
240 DO 241 L=1,730
    K=L-1

```

```

    IF(I-K).EQ.0) 250,242
242 IF(SHIP(I-K).EQ.0) 250,243
243 IF(SHIP(I-K).EQ.1) 244,241
244 E(J)=E(J)+1
241 CONTINUE

```

```

C   C(J) IS COMPUTED AS FOLLOWS
250 DO 251 L=1,730
    K=L-1

```

```

    IF(I-K).EQ.0) 260,252
252 IF(SHIP(I-K).EQ.0) 260,253
253 C(J)=C(J)+1
251 CONTINUE
    K=0

```

```

C   F(J) IS COMPUTED AS FOLLOWS
260 DO 261 K=1,730
    IF(I+K).GT.730) 100,262
262 IF(SHIP(I+K).EQ.0) 100,263
263 F(J)=F(J)+1
261 CONTINUE
205 CONTINUE
100 CONTINUE

```

```

C   DO 4000 I=1,N
4000 IG(I)=G(I)
    L=N-1
    DO 4001 I=1,L
        JJ=N-I
        DO 4002 J=1,JJ
            IF(IG(J)-IG(JJ+1)) 4002,4002,4003
            MM=IG(JJ+1)
            IG(JJ+1)=IG(J)

```



```

IG(J)=MM
4002 CONTINUE
4001 CONTINUE
DO 4005 J=1,N
DO 4010 I=1,N
IF(G(J).EQ.IG(I)) 4011,4010
4011 IF(G(J).EQ.IG(I)) 4012,4013
4012 H(J)=G(J)
GO TO 4005
4013 MM=IG(I)-IG(I-1)
H(J)=MM
GO TO 4005
4010 CONTINUE
4005 CONTINUE

```

C

```

PRINT 500
500 FORMAT(1H1,45X,29HOPERATING SCHEDULES 1962,1963)
PRINT 501
501 FORMAT(1H0,20H0 = CVA NOT DEPLOYED)
PRINT 502
502 FORMAT(1X,28H1 = CVA DEPLOYED AND IN PORT)
PRINT 503
503 FORMAT(1X,27H2 = CVA DEPLOYED AND AT SEA)
PRINT 509
509 FORMAT(1X,21HDATE = YEAR,MONTH,DAY)
DO 504 I=1,4
504 PRINT 505
505 FORMAT(1H )
PRINT 506
506 FORMAT(24X,11HSIXTH FLEET,48X,13HSEVENTH FLEET)
PRINT 507
507 FORMAT(1H0,4HDATE,1X,7(2X,3HCVA),18X,4HDATE,1X,10(2X,3HCVA))
PRINT 508
508 FORMAT(8X,2H11,3X,2H38,3X,2H42,3X,2H59,3X,2H60,3X,2H62,3X,2H65,
126X,2H14,3X,2H16,3X,2H19,3X,2H31,3X,2H34,3X,2H41,3X,2H43,3X,
12H61,3X,2H63,3X,2H64)
DO 510 I=1,2

```


APPENDIX II A

```

510 PRINT 511
511 FORMAT(IX,119(1H--))
    DO 512 I=1,730
    PRINT 513,DATE(I),I11(I),I38(I),I42(I),I59(I),I60(I),I62(I),
    1I65(I),DATE(I),I14(I),I16(I),I19(I),I31(I),I34(I),I41(I),I43(I),
    1I61(I),I63(I),I64(I)
513 FORMAT(IX,I5,3X,7(I1,4X),I5X,I5,3X,10(I1,4X))
    PRINT 514
514 FORMAT(IX,119(1H--))
512 CONTINUE
    PRINT 600
600 FORMAT(1H1,29HLISTING OF COMPUTED VARIABLES)
    PRINT 601
601 FORMAT(1H0,4HCODE)
    PRINT 602
602 FORMAT(IX,55HA = NUMBER OF DAYS AT SEA IMMEDIATELY PRIOR TO ACCIDE
    INT)
    PRINT 603
603 FORMAT(IX,56HB = NUMBER OF DAYS IN PORT IMMEDIATELY PRIOR TO ACCID
    IENT)
    PRINT 604
604 FORMAT(IX,63HC = NUMBER OF DAYS SINCE BEGINNING OF DEPLOYMENT UNTI
    1L ACCIDENT)
    PRINT 605
605 FORMAT(IX,70HD = NUMBER OF DAYS AT SEA SINCE BEGINNING OF DEPLOYME
    INT UNTIL ACCIDENT)
    PRINT 606
606 FORMAT(IX,71HE = NUMBER OF DAYS IN PORT SINCE BEGINNING OF DEPLOYM
    IENT UNTIL ACCIDENT)
    PRINT 607
607 FORMAT(IX,58HF = NUMBER OF DAYS AFTER ACCIDENT UNTIL DEPLOYMENT IS
    1 OVER)
    PRINT 608
608 FORMAT(IX,54HG = NUMBER OF DAYS SINCE 1 JANUARY 1962 UNTIL ACCIDEN
    IT)
    PRINT 630
630 FORMAT(IX,63HH = NUMBER OF DAYS (REGARDLESS OF DEPLOYMENT) BETWEEN
    1

```


APPENDIX II A

```
1 ACCIDENTS)
  PRINT 609
609 FORMAT(1H0,4HNASC)
  PRINT 610
610 FORMAT(1X,10HIDENTIFIER,16X,1HA,5X,1HB,5X,1HC,5X,1HD,5X,1HE,5X,
1HF,5X,1HG, 5X,1HH,4X,3HCVA,3X,5HFLEET)
  PRINT 611
  PRINT 611
611 FORMAT(1X,119(1H-))
  DO 620 J=1,300
  IF(IND(J).EQ.0) 621,622
621 PRINT 623,IDATE(J),KK(J),LL(J),A(J),B(J),C(J),D(J),E(J),F(J),G(J),
1H(J),ICVA(J),FLT(J)
623 FORMAT(1X,I5,A8,A8,3X,8(I3,3X),1X,I2,6X,I1)
  GO TO 625
622 PRINT 624,IDATE(J),KK(J),LL(J),G(J),H(J),ICVA(J)
624 FORMAT(1X,I5,A8,A8,1X,36HACCIDENT DID NOT OCCUR ON DEPLOYMENT,2X,
12(I3,3X),1X,I2)
625 PRINT 514
620 CONTINUE
  END
  END
  FINIS
-EXECUTE.
```


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B. PROGRAM PLOT

The following two programs draw graphs from the NASC data. The nature of each graph is explained by comments in the program listing. Input data cards are the sets of three NASC cards per accident. The value for N(statement 6) is the number of accidents to be plotted. In those cases where the input format is alphabetic, test variables are written into the program in "A" fields. The actual data is also read into the computer in "A" fields and tested against the test variables. The results of the tests determine the floating point value which will be assigned to the variable.

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APPENDIX II B

```

..JOB0161F,POWELL, W.W.
PROGRAM PLOT
DIMENSION X(900), Y(900), DATA(304), ITITLE(12)
DIMENSION IDATE(304), IPT(304), ITIT(304)
DIMENSION ITL3M(304), ITITL3M(304), INTL3M(304)
DIMENSION ITIME(304), IRANK(304)
N=300
DO 1000 I=1,N
  READ 1001, IDATE(I), ITIME(I)
  1001 FORMAT ( I1, 27X, I1)
  PRINT 3000, IDATE(I), ITIME(I)
  3000 FORMAT(1X, I1, I1)
  READ 1002, IRANK(I), IPT(I), ITL3M(I), ITIT(I), ITITL3M(I), INTL3M(I)
  1002 FORMAT (/, 31X, I1, 23X, I2, I2, 2X, I2, 1X, I2, 4X, I2)
  PRINT 3001, IRANK(I), IPT(I), ITL3M(I), ITIT(I), ITITL3M(I), INTL3M(I)
  3001 FORMAT(1X, 6I4)
1000 CONTINUE
C GRAPHS G1 THROUGH G8 ARE FOR THE COMBINED FLEETS FOR 1962 AND 1963
C UNLESS OTHERWISE SPECIFIED
C
C GRAPH G1 PLOTS TOTAL PILOT TIME VS. NUMBER OF ACCIDENTS
C
  XINC = 500.
  INT = 15
  DO 1 I = 1, N
    IPT(I) = IPT(I)*100 + 50
    DATA(I) = IPT(I)
    1 CONTINUE
    DO 2 I = 1, 12
      ITITLE(I) = 8H
      ITITLE(1)=8H POWELL
      ITITLE(2)=8HW. W.
      ITITLE(7) = 8HGI
      X(1) = 0.0
      Y(1) = 0.0
      IQ=4H
      DO 3 I = 1, INT

```


APPENDIX II B

```

X(I+1) = X(I) + XINC
Y(I+1) = 0.0
3 CONTINUE
DO 4 J = 1,N
DO 5 I = 1,INT
IF( DATA(J)- X(I)) 6,6,5
6 Y(I) = Y(I) + 1.0
GO TO 4
5 CONTINUE
4 CONTINUE
DO 7 I = 1,INT
7 X(I) = X(I) - XINC/2.0
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,1,LAST)
C
C GRAPH G2 PLOTS TOTAL PILOT TIME VS. NUMBER OF ACCIDENTS FOR 1962
C
X(1) = 0.0
Y(1) = 0.0
DO 10 I = 1,INT
X(I+1) = X(I) + XINC
Y(I+1) = 0.0
10 CONTINUE
ITITLE(7) = 8HG2
LQ=4H
DO 11 J = 1,N
IF(IDATE(J)-2) 13,13,11
13 DO 12 I = 1,INT
IF(DATA(J)-X(I)) 14,14,12
14 Y(I) = Y(I) + 1.0
GO TO 11
12 CONTINUE
11 CONTINUE
DO 15 I = 1,INT
15 X(I) = X(I) - XINC/2.0
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,1,LAST)
C
C GRAPH G3 PLOTS TOTAL PILOT TIME VS. NUMBER OF ACCIDENTS FOR 1963

```

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APPENDIX II B

```

X(1) = 0.0
Y(1) = 0.0
DO 20 I = 1,INT
  X(I+1) = X(I) + XINC
  Y(I+1) = 0.0
20 CONTINUE
ITITLE(7) = 8HG3
LQ=4H
DO 21 J = 1,N
  IF(IDATE(J)-3) 23,23,21
23 DO 22 I = 1,INT
  IF(DATA(J)-X(I)) 24,24,22
24 Y(I) = Y(I) + 1.0
GO TO 21
22 CONTINUE
21 CONTINUE
DO 25 I = 1,INT
  X(I) = X(I) - XINC/2.0
  CALL DRAW(INT,X,Y,0,0,LQ,

```

C GRAPH G4 PLOTS TIME IN TYPE AIRCRAFT VS. NUMBER OF ACCIDENTS

```

DO 70 I = 1,N
  ITIT(I) = ITIT(I)*10 + 5
  DATA(I) = ITIT(I)
70 CONTINUE
XINC=100.0
INT=15
ITITLE(7) = 8HG4
LQ=4H
X(1) = 0.0
Y(1) = 0.0
DO 71 I = 1,INT
  X(I+1) = X(I) + XINC
  Y(I+1) = 0.0
71 CONTINUE

```

16


```
C
C GRAPH G5 PLOTS TIME LAST THREE MONTHS VS. NUMBER OF ACCIDENTS
C
DO 74 J = 1,N
DO 75 I = 1,INT
IF(DATA(J)-X(I)) 76,76,75
76 Y(I) = Y(I) + 1.0
GO TO 74
75 CONTINUE
74 CONTINUE
DO 77 I = 1,INT
77 X(I) = X(I) - XINC/2.0
CALL DRAW(INT,X,Y,0,C,LQ,ITITLE,0,0,0,0,0,5,5,1,1,LAST)
C
C GRAPH G5 PLOTS TIME LAST THREE MONTHS VS. NUMBER OF ACCIDENTS
C
DO 80 I = 1,N
ITL3M(I) = ITL3M(I)*10 + 5
DATA(I) = ITL3M(I)
80 CONTINUE
XINC = 20.
INT = 20
ITITLE(7) = 8HG5
LQ=4H.
X(1) = 0.0
Y(1) = 0.0
DO 81 I = 1,INT
X(I+1) = X(I) + XINC
Y(I+1) = 0.0
81 CONTINUE
DO 84 J = 1,N
DO 85 I = 1,INT
IF(DATA(J)-X(I)) 86,86,85
86 Y(I) = Y(I) + 1.0
GO TO 84
85 CONTINUE
84 CONTINUE
DO 87 I = 1,INT
X(I) = X(I) - XINC/2.0
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,5,5,1,1,LAST)
C
```


C
C GRAPH G6 PLOTS TIME IN TYPE LAST THREE MONTHS VS. NUMBER OF ACCIDENTS
C

```
DO 90 I = 1,N
  ITITL3M(I) = ITITL3M(I)*10 + 5
  DATA(I) = ITITL3M(I)
```

90 CONTINUE

`TITLE(7) = 8HG6`

 $LQ=4H$
$$x(1) = 0.0$$
$$Y(1) = 0.0$$

DO 91 I = 1,INT

$$X(I+1) = X(I) + XINC$$
$$Y(I+1) = 0.0$$

91 CONTINUE

DO 94 J = 1, N

DO 95 I = 1,INT

IF(DATA(J)-X(I)) 96,96,95

$$96 \quad Y(I) = Y(I) + 1.0$$

GO TO 94

95 CONTINUE

94 CONTINUE

DO 97 I = 1,INT

97 X(I) = X(I) - XINC/2.0

```
CALL DRAW(INT,X,Y,O,O,LQ,ITITLE,O,O,O,O,O,O,5,5,1,1,1,1)
```

C

C GRAPH G7 PLOTS NIGHT TIME LAST THREE MONTHS VS. NUMBER OF NIGHT ACCIDENTS

U

XINC = 5.0

$$\text{INT} = 20$$

DO 100 I = 1, N,

```
100 DATA(I) = INTL3M(I)
```

ITITLE(7) = 8HG7

 $LQ=4H$
$$X(1) = 0.0$$
$$Y(1) = 0.0$$

DO 103 I = 1,INT

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```

X(I+1) = X(I) + XINC
Y(I+1) = 0.0
103 CONTINUE
NUMBER = 0
DO 104 J=1,N
IF(ITIME(J)-4) 104,105,104
105 NUMBER = NUMBER + 1
DO 106 I = 1,INT
IF(DATA(J)-X(I)) 107,107,106
107 Y(I) = Y(I) + 1.0
GO TO 104
106 CONTINUE
104 CONTINUE
DO 108 I = 1,INT
X(I) = X(I)-XINC/2.0
CALL DRAW(INT,X,Y,0.0,LQ,ITITLE,0.0,0.0,0.0,5,5,1,1,LAST)

```

U U U

GRAPH G8 PLOTS PILOTS RANK VS. NUMBER OF ACCIDENTS

```

XINC = 1.0
INT = 10
DO 110 I=1,N
110 DATA(I) = IRANK(I)
ITITLE(7) = 8HG8
LQ=4H
X(1) = 0.0
Y(1) = 0.0
DO 113 I = 1,INT
X(I+1) = X(I) + XINC
Y(I+1) = 0.0
113 CONTINUE
DO 114 J = 1,N
DO 115 I=1,INT
IF(DATA(J)-X(I)) 115,116,115
116 Y(I) = Y(I) + 1.0
GO TO 114
115 CONTINUE

```

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APPENDIX II B

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APPENDIX II B

```

..JOB0161F,POWELL
PROGRAM PLOT
  DIMENSION LANDT(13),LAND(300),DATA(300),ITITLE(12),X(900),Y(900),
  1IYRST(13),IYRS(300),IWEA(1500),INST(300),IPHASE(300),INJ(300),
  1IDAM(300),IOPERS(600)
  N=300
  READ 1000,(LANDT(I),I=1,13)
  1000 FORMAT(13A1)
  READ 1000,(IYRST(I),I=1,13)
  READ 1001,IWEAT
  1001 FORMAT(A1)
  READ 1002,INJT1,INJT2
  1002 FORMAT(2A1)
  READ 1003,IDAMT1,IDAMT2,IDAMT3
  1003 FORMAT(3A1)
  READ 1004,IOPERST
  1004 FORMAT(A2)
  DO 1005 I=1,N
  II=5*I-4
  JJ=5*I-3
  KK=5*I-2
  LL=5*I-1
  MM=5*I
  III=2*I-1
  JJJ=2*I
  READ 1006,IDAM(I),INJ(I),IPHASE(I),IWEA(II),IWEA(JJ),IWEA(KK),
  1IWEA(LL),IWEA(MM),IOPERS(III),IOPERS(JJJ)
  1006 FORMAT(8X,A1,A1,22X,I1,9X,5A1,6X,2A2)
  READ 1007,IYRS(I),LAND(I),INST(I)
  1007 FORMAT(/,39X,A1,27X,A1,I2)
  1005 CONTINUE
  DO 600 I=1,12
  600 ITITLE(I)=8H
  ITITLE(1)=8HPOWELL
  ITITLE(2)=8HW.W.

```

C

C GRAPH G9 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF CV LANDINGS

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APPENDIX II B.

C

```
XINC=50.0
INT=10
DO 1 I=1,N
  IF(LAND(I)-LANDT(1))2,3,2
  3 DATA(I)=5.
  GO TO 1
  2 IF(LAND(I)-LANDT(2))4,5,4
  5 DATA(I)=15.
  GO TO 1
  4 IF(LAND(I)-LANDT(3))6,7,6
  7 DATA(I)=25.
  GO TO 1
  6 IF(LAND(I)-LANDT(4))8,9,8
  9 DATA(I)=35.
  GO TO 1
  8 IF(LAND(I)-LANDT(5))10,11,10
  11 DATA(I)=45.
  GO TO 1
  10 IF(LAND(I)-LANDT(6))12,13,12
  13 DATA(I)=55.
  GO TO 1
  12 IF(LAND(I)-LANDT(7))14,15,14
  15 DATA(I)=65.
  GO TO 1
  14 IF(LAND(I)-LANDT(8))16,17,16
  17 DATA(I)=75.
  GO TO 1
  16 IF(LAND(I)-LANDT(9))18,19,18
  19 DATA(I)=85.
  GO TO 1
  18 IF(LAND(I)-LANDT(10))20,21,20
  21 DATA(I)=95.
  GO TO 1
  20 IF(LAND(I)-LANDT(11))22,23,22
  23 DATA(I)=150.
  GO TO 1
```

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APPENDIX II B

```
106 DATA(I)=2.0
GO TO 100
105 IF(IYRS(I)-IYRST(4))107,108,107
108 DATA(I)=3.0
GO TO 100
107 IF(IYRS(I)-IYRST(5))109,110,109
110 DATA(I)=4.
GO TO 100
109 IF(IYRS(I)-IYRST(6))111,112,111
112 DATA(I)=5.0
GO TO 100
111 IF(IYRS(I)-IYRST(7))113,114,113
114 DATA(I)=6.0
GO TO 100
113 IF(IYRS(I)-IYRST(8))115,116,115
116 DATA(I)=7.0
GO TO 100
115 IF(IYRS(I)-IYRST(9))117,118,117
118 DATA(I)=8.0
GO TO 100
117 IF(IYRS(I)-IYRST(10))119,120,119
120 DATA(I)=9.0
GO TO 100
119 IF(IYRS(I)-IYRST(11))121,122,121
122 DATA(I)=12.
GO TO 100
121 IF(IYRS(I)-IYRST(12))123,124,123
124 DATA(I)=17.5
GO TO 100
123 IF(IYRS(I)-IYRST(13))125,126,125
126 DATA(I)=22.
GO TO 100
125 DATA(I)=0.0
GO TO 100
100 CONTINUE
ITITLE(7)=8HG10
LQ=4H
```


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APPENDIX II B

```

X(1)=0.0
Y(1)=0.0
DO 130 I=1,INT
X(I+1)=X(I)+XINC
Y(I+1)=0.0
130 CONTINUE
DO 134 J=1,N
DO 135 I=1,INT
IF(DATA(J)-X(I))136,136,135
136 Y(I)=Y(I)+1.0
GO TO 134
135 CONTINUE
134 CONTINUE
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,5,5,1,L1ST)
C
C GRAPH G11 PLOTS NUMBER OF ACCIDENTS VS. INSTRUMENT HOURS LAST THREE
C MONTHS FOR ACCIDENTS INVOLVING WEATHER
C
NN=0
DO 200 I=1,N
M=I*5-4
L=I*5
DO 201 J=M,L
IF(IWEA(J)-IWEAT)201,203,201
203 NN=NN+1
DATA(NN)=INST(I)
201 CONTINUE
200 CONTINUE
XINC=5.0
INT=6
ITITLE(7)=8HG11
LQ=4H
X(1)=0.0
Y(1)=0.0
DO 210 I=1,INT
X(I+1)=X(I)+XINC
Y(I+1)=0.0
```

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APPENDIX II B

0123456789ABC
0123456789AJB
7
AU
ABC
B1

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C. PROGRAM PLOT

The following two programs draw graphs of the data computed in PROGRAM THESIS. The graphs are explained in appropriate comments in the program listings. Input consists of the computed variables as identified in THESIS. N is the number of accidents. The programs print the input data as output as a check on the results.

APPENDIX II C

```

..JOB0161F,POWELL,W.W.
PROGRAM PLOT
DIMENSION A(300),B(300),C(300),D(300),E(300),F(300),G(300),
1ITITLE(12),X(900),Y(900)
DIMENSION H(300)
N=173
PRINT 1002
1002 FORMAT(1H1,3X,1HA,3X,1HB,3X,1HC,3X,1HD,3X,1HE,3X,1HF,3X,1HG,3X,
11HH)
DO 1000 I=1,N
READ 1001,A(I),B(I),C(I),D(I),E(I),F(I),G(I),H(I)
1001 FORMAT(21X,8F4.0)
PRINT 1003,A(I),B(I),C(I),D(I),E(I),F(I),G(I),H(I)
1003 FORMAT(1X,8F4.0)
1000 CONTINUE
C
C GRAPH G14 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF DAYS AT SEA IMMEDIATELY
C PRIOR TO ACCIDENT
C
DO 1 I=1,12
1 ITITLE(I)=8H
ITITLE(1)=8HPOWELL
ITITLE(2)=8HW.W.
ITITLE(7)=8HG14
XINC=5.0
INT=6
X(1)=0.0
Y(1)=0.0
LG=4H
DO 3 I=1,INT
X(I+1)=X(I)+XINC
Y(I+1)=0.0
3 CONTINUE
DO 4 J=1,N
DO 5 I=1,INT
IF(A(J)-0.0)9,4,9
9 IF(A(J)-X(I))6,6,5

```


APPENDIX II C

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APPENDIX II C

```
X(I+1)=X(I)+XINC
Y(I+1)=0.0
21 CONTINUE
DO 24 J=1,N
DO 25 I=1,INT
IF(C(J)-0.0)29,24,29
29 IF(C(J)-X(I))26,26,25
26 Y(I)=Y(I)+1.0
GO TO 24
25 CONTINUE
24 CONTINUE
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G17 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF DAYS AT SEA SINCE
C BEGINNING OF DEPLOYMENT UNTIL ACCIDENT
C
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```
XINC=15.0
INT=10
ITITLE(7)=8HG17
LQ=4H.
X(1)=0.0
Y(1)=0.0
DO 31 I=1,INT
X(I+1)=X(I)+XINC
Y(I+1)=0.0
31 CONTINUE
DO 34 J=1,N
DO 35 I=1,INT
IF(D(J)-0.0)39,34,39
39 IF(D(J)-X(I))36,36,35
36 Y(I)=Y(I)+1.0
GO TO 34
35 CONTINUE
34 CONTINUE
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
```

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C
C GRAPH G18 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF DAYS IN PORT SINCE
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APPENDIX II C

```
XINC=15.0
INT=10
ITITLE(7)=8HGL8
LQ=4H
```

```
X(1)=0.0
Y(1)=0.0
DO 41 I=1,INT
X(I+1)=X(I)+XINC
Y(I+1)=0.0
```

41 CONTINUE

DO 44 J=1,N

DO 45 I=1,INT

$$IF(E(J)-0.0)49,44,49$$
49 $IF(E(J)-X(I))46,46,45$
$$46 \quad Y(I) = Y(I) + 1.0$$

GO TO 44

45 CONTINUE

44 CONTINUE

```
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1, LAST)
STOP
END
END
```

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APPENDIX II C

```

DO 1 I=1,12
1 ITITLE(I)=8H
  ITITLE(1)=8HPOWELL
  ITITLE(2)=8H*.W.
  ITITLE(7)=8HG19
  XINC=30.0
  INT=8
  LQ=4H

```

```
X(1)=0.0
Y(1)=0.0
DO 3 I=1,INT
X(I+1)=X(I)+XINC
Y(I+1)=0.0
```

```

3 CONTINUE
DO 4 J=1,N
DO 5 I=1,INT
    IF(F(J)-0.0)9,4,9
9    IF(F(J)-X(I))6,6,5
6    Y(I)=Y(I)+1.0
GO TO 4
5 CONTINUE
4 CONTINUE

```

```
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1, LAST)
```

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APPENDIX II C

```
XINC=30.0
INT=25
L=N-1
```

$$\begin{aligned} 55 \quad Z &= G(JJ+1) \\ G(JJ+1) &= G(J) \\ G(J) &= Z \end{aligned}$$

```
X(1)=0.0
Y(1)=0.0
LQ=4H
DO 11 I=1,INT
X(I+1)=X(I)+XINC
Y(I+1)=0.0
```

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GO TO 14
15 CONTINUE
14 CONTINUE
DO 17 I=2,INT
17 Y(I)=Y(I)+Y(I)

```

```
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,1,1,1,1,1)
```

```
XINC=2.0
INT=8
ITITLE(7)=8HG21
```

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APPENDIX II C

```
LQ=4H
X(1)=0.0
Y(1)=0.0
DO 21 I=1,INT
X(I+1)=X(I)+XINC
Y(I+1)=0.0
21 CONTINUE
DO 24 J=1,N
DO 25 I=1,INT
IF(H(J)-X(I))26,26,25
26 Y(I)=Y(I)+1.0
GO TO 24
25 CONTINUE
24 CONTINUE
CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,1, LAST)
STOP
END
END
```

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